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Brunner & Suddarth's

Textbook of Medical-Surgical Nursing

Second South Asian Edition

Volume II

As per the competency-based syllabus prescribed by Indian Nursing Council

SAE Editors:

Suresh K. Sharma • S. Madhavi

International Editors:

Janice L. Hinkle • Kerry H. Cheever

Highlights:

- Content as per the revised competency-based B.Sc. Nursing curriculum outlined by Indian Nursing Council (INC)
- Sequential arrangement of chapters as per Adult Health Nursing I and II curriculum
- Inclusion of new disease conditions, concepts, and guidelines
- Online ancillaries for students and faculties

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Preface

Brunner & Suddarth's Textbook of Medical-Surgical Nursing was published for the first time in 1964 under the leadership of Lillian Sholtis Brunner and Doris Smith Suddarth. Lillian and Doris pioneered a medical-surgical nursing textbook that has become a trusted learning resource all over the world. Medical-surgical nursing has significantly advanced since 1964 but continues to be strongly influenced by the expansion of a host of other disciplines and new developments in technology, as well as myriad social, cultural, economic, and environmental changes throughout the world. In today's environment, nurses must be particularly skilled in critical thinking and clinical decision making, as well as in consulting and collaborating with other members of the multidisciplinary healthcare team.

Since its inception, *Brunner & Suddarth's Textbook of Medical-Surgical Nursing* has significantly contributed into nursing education in Asia to prepare nurses to think critically and practice collaboratively within today's challenging and complex healthcare delivery system. The textbook focuses on physiologic, pathophysiologic, and psychosocial concepts as they relate to nursing care, and emphasis is placed on integrating a variety of concepts from other disciplines such as nutrition, pharmacology, and gerontology. Content relative to health care needs of nursing research findings, ethical considerations, evidence-based practice, prioritization, and people with disabilities has been expanded to provide opportunities for the nurse to refine clinical decision-making skills.

The several revised editions of *Brunner & Suddarth's Textbook of Medical-Surgical Nursing* were published over time to meet the advanced needs of the nurses and they are religiously used by the nursing fraternity around the globe; however, every region, continent, and country has its distinct contemporary health issues and healthcare infrastructure. Many clinical conditions and clinical perspectives are unique to India and other South Asian countries and their management guidelines are getting updated rapidly. The second South Asian edition of *Brunner & Suddarth's Textbook of Medical-Surgical Nursing* is designed to include these updates as well as conform to the competency-based curriculum outlined by the Indian Nursing Council.

Organization of the Second South Asian Edition

Brunner & Suddarth's Textbook of Medical-Surgical Nursing, the second South Asian Edition, is organized into two volumes spread across 22 units. These units mirror the undergraduate nursing curriculum prescribed by the Indian Nursing Council (INC). Units I through III cover core concepts related to medical-surgical nursing practice and Units IV through XXII discuss adult health conditions that are treated medically or surgically. Each of these units is structured in the following way to facilitate better comprehension:

- The first chapter in the unit covers assessment and includes a review of normal anatomy and physiology of the body system being discussed.
- Subsequent chapters in the unit cover management of specific disorders, pathophysiology, clinical manifestations, assessment and diagnostic findings, medical management, and nursing management. Nursing Process sections, provided for selected conditions, clarify and expand on the nurse's role in caring for patients with these conditions.

Special Features

When caring for patients, nurses assume many different roles, including practitioner, educator, advocate, and researcher. Many of the features in this textbook have been developed to help nurses fulfill these varied roles. Key updates to practice-oriented features in the second South Asian edition include new topics such as ethical and legal issues in surgical nursing, operation theater (OT) (types, design, and infrastructure), instruments and preparation of sets for common surgical procedures, types of suture materials and suture techniques used, monitoring of patients during surgical procedure, maintenance of therapeutic environment in OT, assisting in major and minor surgeries, handling of different specimens, legal aspects in OT, position and draping for common surgical procedures, wound dressing (types and techniques), management of patients with LVH, cor pulmonale, cyst of the liver, gall bladder cancer, tumors of parathyroid gland, Covid-19, swine flu, Pott's spine, chikungunya, and neurocysticercosis.

The mandatory module content on palliative care is readily available as one exclusive chapter.

Indian and Asian epidemiology of diseases and disorders is incorporated along with flowcharts of pathophysiology of diseases and disorders to facilitate the understanding of pathological basis of illnesses. In addition, Indian images and figures have been included, wherever needed, to facilitate better understanding and contemporary closeness to the content. Content specific to Indian context such as AIDS Control Program, agencies involved in AIDS prevention, counseling of AIDS patients, palliative care in the Indian scenario, National Program for the Health Care of Elderly, breaking bad news to patients and/or their families, various skin rejuvenation techniques, gender reassignment surgery, legal and ethical issues in plastic surgery, AERB regulation, radiation safety, National Policy on Disaster Management, legal issues, and Indian resources is provided with additional and latest information.

This edition also includes the most valuable features of the textbook such as Procedural Guidelines for important procedures, Critical Thinking Exercises, Nursing Alerts, Plan of Nursing Care charts, Genetics in Nursing Practice charts, Ethical Dilemma charts, and Home Care Checklist charts which provide relevant formats and updated information.

We are confident that *Brunner & Suddarth's Textbook of Medical-Surgical Nursing*, second South Asian Edition, will continue to be the most preferred textbook for the subject of Adult Health Nursing to cater the needs of Indian/Asian student nurses.

Prof. Dr. Suresh K. Sharma and Prof. Dr. S. Madhavi

Acknowledgments

This edition of *Brunner & Suddarth's Textbook of Medical-Surgical Nursing* is the result of collaboration with authors/editors of the international edition and the overwhelming response received for the first South Asian Edition. The adaptation of this exceptional textbook would not have been possible without the support of the following people:

- For the content contribution, suggestions, and support in adaptation of this textbook, I wish to acknowledge the following of my colleagues:
  - Priya Sharma, Tutor, College of Nursing, All India Institute of Medical Sciences (AIIMS), Jodhpur, Rajasthan, for her overall contribution in revision of the content of this edition.
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  - Satheesh and Pooja, amazingly organized and talented individuals, who have done considerable behind-the-scenes work that has improved the accuracy and consistency in how we present content within the textbook. They too have limitless energy and are always willing to go the extra mile.
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  - My colleague Nipin Kalal, Assistant Professor, College of Nursing, AIIMS-Jodhpur, for his academic support toward the development of quality content for this textbook.
  - My wife Reena Sharma, daughter Simone Sharma, and Son Rishit Sharma who have provided me constant encouragement to keep going, even as they reminded me that there is life beyond the pages of a book. Above all, attendance of gratitude to my father Sh. Badri Narayan Sharma, whose unconditional love and belief in my capabilities provided me the energy to take work of this magnitude.
  - Last but not the least, my family, friends, and nursing fraternity of the South Asia for their support, care, and belief in me.

My collaboration toward the adaptation of this internationally renowned textbook gives me immense pleasure that I will be able to contribute to the nursing knowledge and practices and I strive for the nursing excellence in my country.

Suresh K. Sharma

The synergistic efforts and encouragement from many has resulted into the second South Asian edition of *Brunner & Suddarth's Textbook of Medical-Surgical Nursing*. I enjoyed every bit of this work. I owe a big thanks to the management of KMCH College of Nursing; Dr. Nalla G. Palaniswami, Chairman; Dr. Thavamani D. Palaniswami; and Dr. Arun N. Palaniswami for demanding excellence in the pursuit of nursing education and for their constant support to complete this work successfully. I appreciate the support extended by the KMCH family members.

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I want to acknowledge the support and encouragement of my family members—my mother Ms. Pappa, my father Mr. Sambandam, my beloved husband Mr. Ramamoorthy, and my loving kids Niveditha and Narendira Shiva. They encouraged and supported me to accomplish this work.

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64. Management of Patients with Occupational and Industrial Disorders 2087

Appendix A: Diagnostic Studies and Interpretation A-1

Appendix B: Assessment and Management of Patients Who are LGBTQ B-1

Index I-1

Syllabus Mapping to the Contents of this Book

Volume I				
Unit	**Hours**	**Learning Outcomes**	**Content**	**Page No.**
I	6 (T)	Narrate the evolution of medical surgical nursing. Apply nursing process in caring for patients with medical surgical problems	**Introduction** • Evolution and trends of medical and surgical nursing • International classification of diseases	 4 6
		Execute the role of a nurse in various medical surgical setting	• Roles and responsibility of a nurse in medical and surgical settings – Outpatient department – Inpatient unit – Intensive care unit	9
		Develop skills in assessment and care of wound	• Introduction to medical and surgical asepsis – Inflammation, infection – Wound healing – stages, influencing factors – Wound care and dressing technique	 8, 10 139 139
		Develop competency in providing pre- and postoperative care	• Care of surgical patient – Preoperative – Postoperative • Alternative therapies used in caring for patients with medical surgical disorders	 65 128 8
II	11 (T)	Explain organizational set up of the operating theater	**Intraoperative care** • Organization and physical set up of the operation theater – Classification – OT design – Staffing – Members of the OT team	83
		Differentiate the role of scrub nurse and circulating nurse	• Duties and responsibilities of the nurse in OT	
		Describe the different positioning for various surgeries	• Position and draping for common surgical procedures • Instruments, sutures and suture materials, equipment for common surgical procedures	
		Apply principles of asepsis in handling the sterile equipment	• Disinfection and sterilization of equipment • Preparation of sets for common surgical procedures	
		Demonstrate skill in scrubbing procedures	• Scrubbing procedures – gowning, masking, and gloving	
		Demonstrate skill in assessing the patient and document accurately the surgical safety checklist	• Monitoring the patient during the procedures • Maintenance of the therapeutic environment in OT	
		Develop skill in assisting with selected surgeries	• Assisting in major and minor operation, handling specimen • Prevention of accidents and hazards in OT	
		Explain the types, functions, and nursing considerations for different types of anesthesia	• Anesthesia – types, methods of administration, effects and stages, equipment & drugs • Legal aspects	

Unit	Hours	Learning Outcomes	Content	Page No.
III	6 (T)	Identify the signs and symptoms of shock and electrolyte imbalances Develop skills in managing fluid and electrolyte imbalances Perform pain assessment and plans for the nursing management	**Nursing care of patients with common signs and symptoms and management** • Fluid and electrolyte imbalance • Shock • Pain	 159 199 226
IV	16 (T)	Demonstrate skill in respiratory assessment Differentiate different breath sounds and list the indications	**Nursing management of patients with respiratory problems** • Review of anatomy and physiology of respiratory system • Nursing assessment – history taking, physical assessment and diagnostic tests	 253 261
		Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of common respiratory problems	• Common respiratory problems: – Upper respiratory tract infections – Chronic obstructive pulmonary diseases – Pleural effusion – Empyema – Bronchiectasis – Pneumonia – Lung abscess – Cyst and tumors – Chest injuries – Acute respiratory distress syndrome – Pulmonary embolism	 329 381 353 354 395 333 351 367 372 356 361
		Describe the health behavior to be adopted in preventing respiratory illnesses	• Health behaviors to prevent respiratory illness	Discussed in respective chapters
V	15 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of gastrointestinal disorders	**Nursing management of patients with disorders of digestive system** • Review of anatomy and physiology of GI system	 421
		Demonstrate skill in gastrointestinal assessment	• Nursing assessment – history and physical assessment	425
		Prepare patient for upper and lower gastrointestinal investigations	• GI investigations	429
			• Common GI disorders: – Oral cavity – lips, gums and teeth – GI – bleeding, infections, inflammation, perforation – Tumors – Obstruction and peritonitis – Peptic and duodenal ulcer – Malabsorption, appendicitis, hernias – Hemorrhoids, fissures, fistulas	 463 463 Discussed in respective chapters 524 & 520 494 509 509

Unit	Hours	Learning Outcomes	Content	Page No.
			– Pancreas – inflammation, cysts, and tumors	953
			– Liver – inflammation, cysts, abscess, cirrhosis, portal hypertension, hepatic failure, tumors	898
			– Gall bladder – inflammation, cholelithiasis, tumors	942
		Demonstrate skill in gastric decompression, gavage, and stoma care	• Gastric decompression, gavage, and different feeding techniques	439
			• Stoma care	534
		Demonstrate skill in different feeding techniques	• Alternative therapies, drugs used in treatment of disorders of digestive system	Discussed in respective chapters
VI	15 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of cardiovascular disorders	**Nursing management of patients with cardiovascular problems**	
			• Review of anatomy and physiology of cardiovascular system	562
		Demonstrate skill in cardiovascular assessment	• Nursing assessment – history and physical assessment	568
		Prepare patient for invasive and noninvasive cardiac procedures	• Disorders of vascular system – hypertension arteriosclerosis, Raynaud's disease, aneurysm and peripheral vascular disorders	773 730
		Demonstrate skill in monitoring and interpreting clinical signs related to cardiac disorders	• Coronary artery diseases – coronary atherosclerosis, angina pectoris, myocardial infarction	635
			• Valvular disorders – congenital and acquired	676
			• Rheumatic heart disease – pericarditis, myocarditis, endocarditis, cardiomyopathies	676
			• Cardiac dysrrhythmias, heart block	599
			• Congestive heart failure, cor pulmonale, pulmonary edema, cardiogenic shock, cardiac tamponade	705
			• Cardiopulmonary arrest	705
VII	7 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of hematological disorders	• Review of anatomy and physiology of blood, nursing assessment – history, physical assessment and diagnostic tests	792
			• Anemia, polycythemia	814
		Interpret blood reports	• Bleeding disorders – clotting factor defects and platelets defects, thalassemia, leukemias, leukopenias, agranulocytosis	814
		Prepare and provide health education on blood donation	• Lymphomas, myelomas	876, 880
VIII	8 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of endocrine disorders	**Nursing management of patients with disorders of endocrine system**	
			• Review of anatomy and physiology of endocrine system	1016
		Demonstrate skill in assessment of endocrine organ dysfunction	• Nursing assessment – history and physical assessment	1018
			• Disorders of thyroid and parathyroid, adrenal and pituitary (hyper, hypo, tumors)	1019
		Prepare and provide health education on diabetic diet Demonstrate skill in insulin administration	• Diabetes mellitus	970

Unit	Hours	Learning Outcomes	Content	Page No.
IX	8 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of disorders of integumentary system	**Nursing management of patients with disorders of integumentary system**	
			• Review of anatomy and physiology of skin	1059
		Demonstrate skill in integumentary assessment	• Nursing assessment – history and physical assessment	1063
		Demonstrate skill in medicated bath	• Infection and infestations: Dermatitis	1074
			• Dermatoses; infectious and non-infectious	
		Prepare and provide health education on skin care	• Acne, allergies, eczema and pemphigus	
			• Psoriasis, malignant melanoma, alopecia	
			• Special therapies, alternative therapies	
			• Drugs used in treatment of disorders of integumentary system	
X	11 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of musculoskeletal disorders	**Nursing management of patients with musculoskeletal problems**	
		Demonstrate skill in musculoskeletal assessment	• Review of anatomy and physiology of the musculoskeletal system	1112
		Prepare patient for radiological and nonradiological investigations of musculoskeletal system	• Nursing assessment – history and physical assessment, diagnostic tests	1117
			• Musculoskeletal trauma: Fracture	1195
			• Dislocation, sprain, strain, contusion, amputation	1183
			• Musculoskeletal infections and tumors: Osteomyelitis, benign and malignant tumor	1165
		Demonstrate skill in crutch walking and splinting	• Orthopedic modalities: Cast, splint, traction, crutch walking	1127
			• Musculoskeletal inflammation: Bursitis, synovitis, arthritis	1156
			• Special therapies, alternative therapies	
			• Metabolic bone disorder: Osteoporosis, osteomalacia and Paget's disease	1165
			• Spinal column defects and deformities – tumor, prolapsed intervertebral disc, Pott's spine	1176
			• Rehabilitation, prosthesis	1209
		Demonstrate skill in care of patient with replacement surgeries	• Replacement surgeries	1140
		Prepare and provide health education on bone healing		
XI	17 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of patients with communicable diseases	**Nursing management of patients with communicable diseases**	1231
			• Overview of infectious diseases, the infectious process	
			• Nursing assessment – history and physical assessment, diagnostic tests	

Unit	Hours	Learning Outcomes	Content	Page No.
		Demonstrate skill in barrier and reverse barrier techniques	• Tuberculosis • Diarrheal diseases, hepatitis A-E, typhoid • herpes, chickenpox, smallpox, measles, mumps, influenza • Meningitis • Gas gangrene • Leprosy • Dengue, plague, malaria, chikungunya, swine flu, filariasis • Diphtheria, pertussis, tetanus, poliomyelitis	
		Demonstrate skill in execution of different isolation protocols	• Special infection control measures: notification, isolation, quarantine, immunization	

Volume II

Unit	Hours	Learning Outcomes	Content	Page No.
I	10 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic measures and medical, surgical, nutritional and nursing management of patients with ENT disorders	**Nursing management of patient with disorders of ear, nose and throat** (Includes etiology, pathophysiology, clinical manifestations, diagnostic measures and medical, surgical, nutritional and nursing management) • Review of anatomy and physiology of the ear, nose and throat • History, physical assessment, and diagnostic tests • **Ear** – External ear: deformities otalgia, foreign bodies and tumors – Middle ear: impacted wax, tympanic, membrane perforation, otitis media, and tumors – Inner ear: Meniere's disease, labyrinthitis, ototoxicity tumors • Upper respiratory airway infections–Rhinitis, sinusitis, tonsillitis, laryngitis • Epistaxis, nasal obstruction, laryngeal obstruction • Deafness and its management	1273, 1302
II	10 (T)	Explain the etiology, patho-physiology, clinical manifestations, diagnostic measures and management of patients with disorders of eye	**Nursing management of patient with disorder of eye** • Review of anatomy and physiology of the eye • History, physical assessment, diagnostic assessment **Eye disorders** • Refractive errors • Eyelids – infection, deformities • Conjunctiva – inflammation and infection bleeding • Cornea – inflammation and infection • Lens – cataract • Glaucoma • Retinal detachment • Blindness	1330
		Describe eye donation, banking and transplantation	• Eye banking, eye donation	

Unit	Hours	Learning Outcomes	Content	Page No.
III	9 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of kidney and urinary system disorders	**Nursing management of patient with kidney and urinary problems** • Review of anatomy and physiology of the genitourinary system	1369
		Demonstrate skill in genitourinary assessment	• History, physical assessment, diagnostic tests	1375
		Prepare patient for genitourinary investigations	• Urinary tract infections – acute, chronic, lower, upper	1434
			• Nephritis, nephrotic syndrome	Nephritis covered in chapters 44 and 45 & 1393
		Prepare and provide health education on prevention of renal calculi	• Renal calculi	1450
			• Acute and chronic renal failure	1387
			• Disorders of ureter, urinary bladder and urethra	1434
			• Disorders of prostate – inflammation, infection, stricture, obstruction, and benign prostate hypertrophy	1469
IV	5 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of male reproductive disorders	**Nursing management of disorders of male reproductive system** • Review of anatomy and physiology of the male reproductive system • History, physical assessment, diagnostic tests • Infections of testis, penis and adjacent structures – phimosis, epididymitis, and orchitis • Sexual dysfunction, infertility, contraception • Male breast disorders - gynecomastia, tumor, climacteric changes	1469
V	8 (T)	Explain the etiology, patho-physiology, clinical manifestations, types, diagnostic measures and management of patients with disorders of burns/cosmetic surgeries and its significance	**Nursing management of patient with burns, reconstructive and cosmetic surgery** • Review of anatomy and physiology of the skin and connective tissues • History, physical assessment, assessment of burns and fluid and electrolyte loss • Burns • Reconstructive and cosmetic surgery for burns, congenital deformities, injuries and cosmetic purposes, gender reassignment • Legal and ethical aspects • Special therapies: LAD, vacuumed dressing, laser, liposuction, skin health rejuvenation, use of derma fillers	1509
VI	16 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic measures and management of patients with neurological disorders	• Review of anatomy and physiology of the neurological system	1543
			• History, physical, neurological assessment, diagnostic tests	1553
			• Headache, head injuries	1600, 1631
			• Spinal injuries – paraplegia, hemiplegia, quadriplegia	1644
			• Spinal cord compression – herniation of intervertebral disc	1728
			• Intra cranial and cerebral aneurysms	1623

Unit	Hours	Learning Outcomes	Content	Page No.
			• Meningitis, encephalitis, brain abscess, neurocysticercosis	1673
			• Movement disorders – seizures, epilepsies, and chorea	1592, 1594 & 1702
			• Cerebrovascular disorders-CVA	
			• Cranial, spinal neuropathies – Bell's palsy, trigeminal neuralgia	1696, 1699
			• Peripheral neuropathies	1699
			• Degenerative diseases - Alzheimer's disease, Parkinson's disease	1712, 1716
			• Guillain-Barré syndrome, myasthenia gravis, and multiple sclerosis	1691, 1689 & 1682
			• Rehabilitation of patient with neurological deficit	1658
VII	12 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic tests, and medical, surgical, nutritional, and nursing management of immunological disorders	**Nursing management of patients with immunological problems**	
		Prepare and provide health education on prevention of HIV infection	• Review of immune system	1740
			• Nursing assessment – history and physical assessment	1748
			• HIV & AIDS: Epidemiology, transmission, prevention of transmission	1767
			• Role of nurse: Counseling, health education and home care consideration	1777
		Describe the national infection control programmes	• National AIDS Control Program – NACO, various national and international agencies, infection control programs	1786
		Describe the drug therapy for AIDS	• Rehabilitation	1789
VIII	10 (T)	Explain the etiology, pathophysiology, types, clinical manifestations, staging, diagnostic measures and management of patients with different cancer, treatment modalities including newer treatments	**Nursing management of patient with oncological conditions** • Structure and characteristics of normal and cancer cells • History, physically assessment, diagnostic tests. • Prevention screening early detections warning sign of cancer • Epidemiology, etiology classification, pathophysiology, staging clinical manifestations, diagnosis, treatment modalities and medical and surgical nursing management of oncological condition • Common malignancies of various body system eye, ear, nose, larynx, breast, cervix, ovary, uterus, sarcoma, renal, bladder, kidney, prostate, brain, spinal cord. • Oncological emergencies • Modalities of treatment – Chemotherapy; radiotherapy – Radiation safety, AERB regulations, surgical intervention, stem cell and bone marrow transplant, immunotherapy, gene therapy	1850 and covered in respective chapters

Unit	Hours	Learning Outcomes	Content	Page No.
			• Psychological aspects of cancer – anxiety, depression, insomnia, anger	
			• Palliative care	1952
			• Supportive care	Discussed in corresponding chapters
			• Hospice care	1954
IX	15 (T)	Explain the types, policies, guidelines, prevention and management of disaster, the etiology, pathophysiology, clinical manifestations, diagnostic measures and management of patients with acute emergencies	**Nursing management of patient in emergency and disaster situations** • Disaster nursing • Concept and principles of disaster nursing, related policies • Types of disaster: Natural and manmade • Disaster preparedness: Team, guidelines, protocols, equipment, resources • Etiology, classification, pathophysiology, staging, clinical manifestation, diagnosis, treatment modalities and medical and surgical nursing management of patient with medical and surgical emergencies – Polytrauma, bites, poisoning and thermal emergencies • Principles of emergency management • Medicolegal aspects	2013 1977
X	8 (T)	Explain the concept, physiological changes, and psychosocial problems of ageing Describe the nursing management of the elderly	**Nursing care of the elderly** • History and physical assessment • Aging process and age-related body changes and psychosocial aspects • Stress and coping in elder patient • Psychosocial and sexual abuse of elderly • Role of family and formal and non-formal caregivers • Use of aids and prosthesis (hearing aids, dentures) • Legal and ethical issues • National programs for elderly, privileges, community programs and health services • Home and institutional care	2035
XI	12 (T)	Explain the etiology, pathophysiology, clinical manifestations, diagnostic measures and management of patients in critical care units	**Nursing management of patients in critical care units** • Principles of critical care nursing • Organization: physical set-up, policies, staffing norms • Protocols, equipment, and supplies, • Special equipment: ventilators, cardiac monitors, defibrillators, infusion pump, resuscitation equipment • Advanced cardiac life support • Nursing management of critically ill patient • Transitional care • Ethical and legal aspects • Breaking bad news to patients and/or their families—Communication with patient and family • End of life care	2061
XII	5 (T)	Describe the etiology, pathophysiology, clinical manifestations, diagnostic measures and management of patients with occupational/ industrial health disorders	**Nursing management of patients occupational and industrial disorders** • History, physical examination, diagnostic tests • Occupational diseases and management	2087

UNIT

XII Sensory Function

Chapter 40 Assessment and Management of Patients with Nose and Throat Disorders 1273

Chapter 41 Assessment and Management of Patients with Hearing and Balance Disorders 1302

Chapter 42 Assessment and Management of Patients with Eye and Vision Disorders 1329

CHAPTER 40

Assessment and Management of Patients with Nose and Throat Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe nursing management of patients with upper airway disorders.
2. Compare and contrast the upper respiratory tract infections according to cause, incidence, clinical manifestations, management, and the significance of preventive health care.
3. Apply the nursing process as a framework for care of patients with upper airway infection.
4. Describe nursing management of the patient with epistaxis.
5. Apply the nursing process as a framework for care of patients undergoing laryngectomy.

GLOSSARY

alaryngeal communication: alternative modes of speaking that do not involve the normal larynx; used by patients whose larynx has been surgically removed
aphonia: impaired ability to use one's voice due to disease or injury to the larynx
apnea: cessation of breathing
dysphagia: difficulties in swallowing
epistaxis: hemorrhage from the nose due to rupture of tiny, distended vessels in the mucous membrane of any area of the nose
herpes simplex (cold sore): a cutaneous viral infection with painful vesicles and erosions on the tongue, palate, gingiva, buccal membranes, or lips
laryngectomy: surgical removal of all or part of the larynx and surrounding structures
laryngitis: inflammation of the larynx; may be caused by voice abuse, exposure to irritants, or infectious organisms
nuchal rigidity: stiffness of the neck or inability to bend the neck
pharyngitis: inflammation of the throat; usually viral or bacterial in origin
rhinitis: inflammation of the mucous membranes of the nose; may be infectious, allergic, or inflammatory in origin
rhinitis medicamentosa: rebound nasal congestion commonly associated with overuse of over-the-counter nasal decongestants
rhinorrhea: drainage of a large amount of fluid from the nose
rhinosinusitis: inflammation of the nares and paranasal sinuses, including frontal, ethmoid, maxillary, and sphenoid sinuses; replaces the term *sinusitis*
tonsillitis: inflammation of the tonsils, usually due to an acute infection
xerostomia: dryness of the mouth from a variety of causes

Introduction

Upper respiratory tract disorders are those that involve the nose, paranasal sinuses, pharynx, larynx, trachea, or bronchi. Many of these conditions are relatively minor, and their effects are limited to mild and temporary discomfort and inconvenience for the patient. However, others are acute, severe, and life threatening and may require permanent alterations in breathing and speaking. Therefore, the nurse must have expert assessment skills, an understanding of the wide variety of disorders that may affect the upper airway, and an awareness of the impact of these alterations on patients. Patient education is an important aspect of nursing care because many of these disorders are treated outside the hospital or at home by patients themselves. When caring for patients with acute, life-threatening disorders, the nurse needs highly developed assessment and clinical management skills, along with a focus on rehabilitation needs.

UPPER AIRWAY INFECTIONS

Upper airway infections (otherwise known as upper respiratory infections or URIs) are the most common cause of illness and affect most people on occasion. Some infections are acute, with symptoms that last several days; others are chronic, with symptoms that may last for months or recur. URI is defined as an infection of the mucous membranes from the nose down to the respiratory tree or bronchi (Fashner, Erickson, & Werner, 2012).

The common cold is the most frequently occurring example of a URI. URIs occur when microorganisms such as viruses and bacteria are inhaled. There are many causative organisms, and people are susceptible throughout life. Viruses, the most common cause of URIs, affect the upper respiratory passages and lead to subsequent mucous membrane inflammation (Fashner et al., 2012). URIs are the most common reason for seeking health care and for absences from school and work.

URIs affect the nasal cavity; ethmoidal air cells; and frontal, maxillary, and sphenoid sinuses; as well as the pharynx, larynx, and trachea. On average, adults typically develop 2 to 4 URIs per year because of the wide variety of respiratory viruses that circulate in the community. Although patients are rarely hospitalized for the treatment of URIs. Nurses working in community settings or long-term care facilities may encounter patients who have these infections. It is important for nurses to recognize the signs and symptoms of URIs and provide appropriate care. Nurses in these settings also can influence patient outcomes through patient education. Special considerations with regard to URIs in older adults are summarized in Chart 40-1.

Rhinitis

Rhinitis is a group of disorders characterized by inflammation and irritation of the mucous membranes of the nose. These

Chart 40-1

Upper Respiratory Tract Disorders in Older Adults

- Upper respiratory infections in older adults may have more serious consequences if patients have concurrent medical problems that compromise their respiratory or immune status.
- Influenza causes exacerbations of chronic obstructive pulmonary disease and reduced pulmonary function.
- Antihistamines and decongestants used to treat upper respiratory disorders must be used cautiously in older adults because of their side effects and potential interactions with other medications.
- With anticipated future growth in the older adult population, the need for endoscopic sinus surgery will increase. Older patients with CRS present with symptoms similar to those of younger adults and experience a similar degree of improvement and quality of life after endoscopic sinus surgery.
- The structure of the nose changes with aging; it lengthens and the tip droops from loss of cartilage. This can cause restriction in airflow and predispose older adult patients to geriatric rhinitis, characterized by increased thin, watery sinus drainage. These structural changes may also adversely affect the sense of smell.
- Laryngitis in older adults is common and may be secondary to gastroesophageal reflux disease (GERD). Older adults are more likely to have impaired esophageal peristalsis and a weaker esophageal sphincter. Treatment measures include sleeping with the head of the bed elevated and the use of medications such as histamine-2 receptor blockers (e.g., famotidine [Pepcid], ranitidine [Zantac]) or proton pump inhibitors (omeprazole [Prilosec]).
- Age-related loss of muscle mass and thinning of the mucous membranes can cause structural changes in the larynx that may change characteristics of the voice. In general, the pitch of voice becomes higher in older adult men and lower in older adult women. The voice also "thins" (decreased projection) and may sound tremulous. These changes should be discriminated from signs that could indicate pathologic conditions.

Adapted from American Academy of Otolaryngology. (2015). *Fact sheet*: *Sinusitis*: *Special considerations for aging patients*. Retrieved on 10/8/2015 at: www.entnet.org/content/sinusitis-special-considerations-aging-patients

Chart 40-2

Examples of Common Indoor and Outdoor Allergens

Common Indoor Allergens

- Dust mite feces
- Dog dander
- Cat dander
- Cockroach droppings
- Molds

Common Outdoor Allergens

- Trees (e.g., oak, elm, western red cedar, ash, birch, sycamore, maple, walnut, and cypress)
- Weeds (e.g., ragweed, tumbleweed, sagebrush, pigweed, cockle weed, and Russian thistle)
- Grasses (e.g., timothy, orchard, sweet vernal, bermuda, sour dock, redtop, and bluegrass)
- Molds (*Alternaria, Cladosporium, Aspergillus*)

Adapted from Aljubran, S. & Lockey, R. F. (2014) Aeroallergens. Retrieved on 3/9/2016 at www.emedicine.medscape.com/article/137911-overview

conditions can have a significant impact on quality of life and contribute to sinus, ear, and sleep problems and learning disorders. Rhinitis often coexists with other respiratory disorders, such as asthma. It affects between 10% and 30% of the population worldwide annually. Viral rhinitis, especially the common cold, affects approximately one billion individuals yearly (Krouse & Krouse, 2014).

Rhinitis may be acute or chronic, and allergic or nonallergic. Allergic rhinitis is further classified as seasonal or perennial rhinitis and is commonly associated with exposure to airborne particles such as dust, dander, or plant pollens in people who are allergic to these substances. Seasonal rhinitis occurs during pollen seasons, and perennial rhinitis occurs throughout the year. See Chapter 56 for detailed descriptions of allergic disorders, including allergic rhinitis.

Pathophysiology

Rhinitis may be caused by a variety of factors, including changes in temperature or humidity; odors; infection; age; systemic disease; use of over-the-counter (OTC) and prescribed nasal decongestants; and the presence of a foreign body. Allergic rhinitis may occur with exposure to allergens such as foods (e.g., peanuts, walnuts, Brazil nuts, wheat, shellfish, soy, cow's milk, and eggs), medications (e.g., penicillin, sulfa medications, and aspirin), and particles in the indoor and outdoor environment (see Chart 40-2). The most common cause of nonallergic rhinitis is the common cold (Seidman, Gurgel, Lin, et al., 2015).

Drug-induced rhinitis may occur with antihypertensive agents, such as angiotensin-converting enzyme (ACE) inhibitors and beta-blockers; "statins," such as atorvastatin (Lipitor) and simvastatin (Zocor); antidepressants and antipsychotics such as risperidone (Risperdal); aspirin; and some antianxiety medications. Figure 40-1 shows the pathologic processes involved in rhinitis and rhinosinusitis. Other causes of rhinovirus are identified in Table 40-1.

Clinical Manifestations

The signs and symptoms of rhinitis include rhinorrhea (excessive nasal drainage, runny nose); nasal congestion; nasal discharge (purulent with bacterial rhinitis); sneezing; and pruritus of the nose, roof of the mouth, throat, eyes, and ears. Headache may occur, particularly if rhinosinusitis is also present. Nonallergic rhinitis can occur throughout the year.

Medical Management

The management of rhinitis depends on the cause, which may be identified through the history and physical examination. The nurse asks the patient about recent symptoms as well as possible exposure to allergens in the home, environment, or workplace. If viral rhinitis is the cause, medications may be prescribed to relieve the symptoms. In allergic rhinitis, allergy tests may be performed to identify possible allergens. Depending on the severity of the allergy, desensitizing immunizations and corticosteroids may be required (see Chapter 56 for more details). If symptoms suggest a bacterial infection, an antimicrobial agent is used (see later discussion of rhinosinusitis). Patients with nasal septal deformities or nasal polyps may be referred to an ear, nose, and throat specialist.

Pharmacologic Therapy

Medication therapy for allergic and nonallergic rhinitis focuses on symptom relief. Antihistamines and corticosteroid nasal sprays may be useful. Antihistamines remain the most

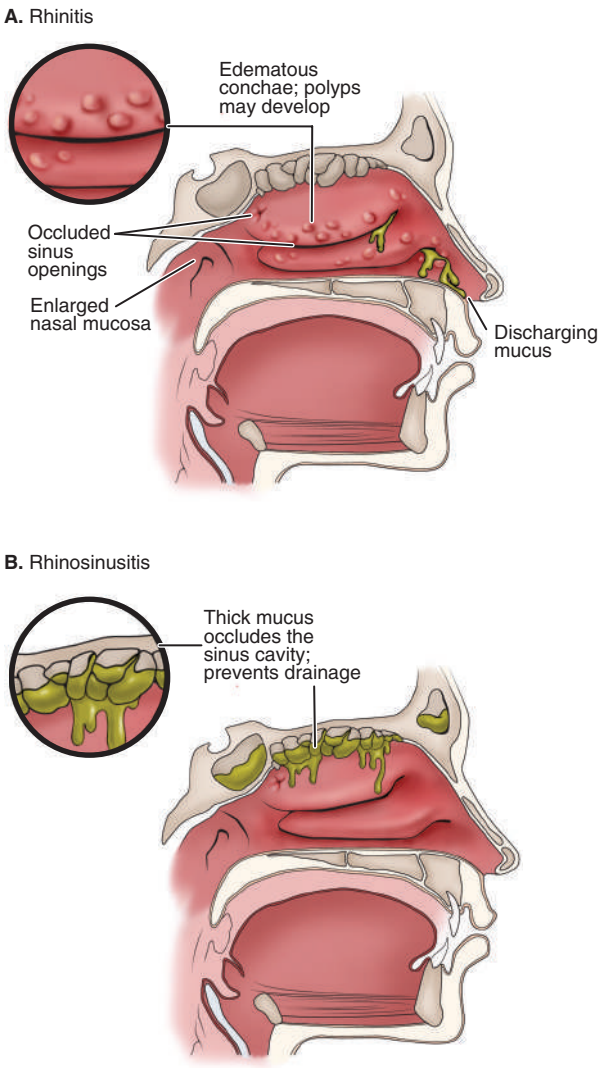


Figure 40-1 • Pathophysiologic processes in rhinitis and rhinosinusitis. Although pathophysiologic processes are similar in rhinitis and rhinosinusitis, they affect different structures. **A.** In rhinitis, the mucous membranes lining the nasal passages become inflamed, congested, and edematous. The swollen nasal conchae block the sinus openings, and mucus is discharged from the nostrils. **B.** Rhinosinusitis is also marked by inflammation and congestion, with thickened mucous secretions filling the sinus cavities and occluding the openings.

common treatment and are given for sneezing, pruritus, and rhinorrhea. (Examples of commonly prescribed antihistamines are discussed in more detail in Chapter 56.) Brompheniramine/pseudoephedrine (Dimetapp) is an example of combination antihistamine/decongestant medications. Cromolyn (NasalCrom), a mast cell stabilizer that inhibits the release of histamine and other chemicals, is also used in the treatment of rhinitis. Oral decongestant agents may be used for nasal obstruction. The use of saline nasal spray can act as a mild decongestant and can liquefy mucus to prevent crusting. Two inhalations of intranasal ipratropium (Atrovent) can be given in each nostril two to three times per day for symptomatic relief of rhinorrhea. In addition, intranasal corticosteroids may be used for severe congestion, and ophthalmic agents (cromolyn ophthalmic solution 4%) may be used to relieve irritation, itching, and redness of the eyes. Appropriate allergy treatments may include leukotriene modifiers (e.g., montelukast [Singulair], zafirlukast [Accolate], zileuton [Zyflo]), and immunoglobulin E modifiers (omalizumab [Xolair]), which are also components of asthma treatment guidelines (discussed further in Chapter 13). The choice of medications depends on the symptoms, adverse reactions, adherence factors, risk of drug interactions, and cost to the patient.

TABLE 40-1 Causes of Rhinosinusitis

Category	Causes
Vasomotor	Idiopathic Abuse of nasal decongestants (rhinitis medicamentosa) Psychological stimulation (anger, sexual arousal) Irritants (smoke, air pollution, exhaust fumes, cocaine)
Mechanical	Tumor Deviated septum Crusting Hypertrophied turbinates Foreign body Cerebrospinal fluid leak
Chronic inflammatory	Polyps (in cystic fibrosis) Sarcoidosis Wegener granulomatosis Midline granuloma
Infectious	Acute viral infection Acute or chronic rhinosinusitis Rare nasal infections (syphilis, tuberculosis)
Hormonal	Pregnancy Use of oral contraceptives Hypothyroidism

Adapted from Peters, A. (2015). Rhinosinusitis: Synopsis. Retrieved on 10/8/2015 at: www.worldallergy.org/professional/allergic_diseases_center/rhinosinusitis/sinusitissynopsis.php

Nursing Management

Educating Patients about Self-Care

The nurse instructs the patient with allergic rhinitis to avoid or reduce exposure to allergens and irritants, such as dusts, molds, animals, fumes, odors, powders, sprays, and tobacco smoke. Patient education is essential when assisting the patient in the use of all medications. To prevent possible drug interactions, the patient is cautioned to read drug labels before taking any OTC medication.

The nurse instructs the patient about the importance of controlling the environment at home and at work. Saline nasal sprays or aerosols may be helpful in soothing mucous membranes, softening crusted secretions, and removing irritants. The nurse instructs the patient in correct administration of nasal medications. To achieve maximal relief, the patient is instructed to blow the nose before applying any medication into the nasal cavity. In addition, the patient is taught to keep the head upright; spray quickly and firmly into each nostril away from the nasal septum; and wait at least 1 minute before administering the second spray. The container should be cleaned after each use and should never be shared with other people to avoid cross-contamination.

In the case of infectious rhinitis, the nurse reviews hand hygiene technique with the patient as a measure to prevent transmission of organisms. This is especially important for those in contact with vulnerable populations such as the very young, older adults, or people who are immunosuppressed

(e.g., patients with human immune deficiency virus [HIV] infection, those taking immunosuppressive medications). In older adults and other high-risk populations, the nurse reviews the importance of receiving an influenza vaccination each year to achieve immunity before the beginning of the flu season.

Viral Rhinitis (Common Cold)

Viral rhinitis is the most frequent viral infection in the general population (Krouse & Krouse, 2014). The term *common cold* often is used when referring to a URI that is self-limited and caused by a virus. The term *cold* refers to an infectious, acute inflammation of the mucous membranes of the nasal cavity characterized by nasal congestion, rhinorrhea, sneezing, sore throat, and general malaise. More broadly, the term refers to an acute URI, whereas terms such as *rhinitis, pharyngitis,* and *laryngitis* distinguish the sites of the symptoms. The term is also used when the causative virus is influenza (the flu). Colds are highly contagious because virus is shed for about 2 days before the symptoms appear and during the first part of the symptomatic phase.

Colds caused by rhinoviruses tend to occur in the early fall and spring. Other viruses tend to cause winter colds (Centers for Disease Control and Prevention [CDC], 2015). Seasonal changes in relative humidity may affect the prevalence of colds. The most common cold-causing viruses survive better when humidity is low, in the colder months of the year.

Colds are caused by as many as 200 different viruses (National Institute of Allergy and Infectious Diseases, 2015). Rhinoviruses are the most likely causative organisms. Other viruses implicated in the common cold include coronavirus, adenovirus, respiratory syncytial virus, influenza virus, and parainfluenza virus. Each virus may have multiple strains; as a result, people are susceptible to colds throughout life. Development of a vaccine against the multiple strains of virus is almost impossible. Immunity after recovery is variable and depends on many factors, including a person's natural host resistance and the specific virus that caused the cold. Despite popular belief, cold temperatures and exposure to cold rainy weather do not increase the incidence or severity of the common cold.

Clinical Manifestations

Signs and symptoms of viral rhinitis may include low-grade fever, nasal congestion, rhinorrhea and nasal discharge, halitosis, sneezing, tearing watery eyes, "scratchy" or sore throat, general malaise, chills, and often headache and muscle aches. As the illness progresses, cough usually appears. In some people, the virus exacerbates herpes simplex, commonly called a *cold sore* (see Chart 40-3).

The symptoms of viral rhinitis may last from 1 to 2 weeks. If severe systemic respiratory symptoms occur, it is no longer considered viral rhinitis but one of the other acute URIs. Allergic conditions can affect the nose, mimicking the symptoms of a cold.

Medical Management

Management consists of symptomatic therapy that includes adequate fluid intake, rest, prevention of chilling, and the use of expectorants as needed. Warm salt-water gargles soothe the sore throat, and nonsteroidal anti-inflammatory drugs

Chart 40-3

Colds and Cold Sores (Herpes Simplex Virus)

Herpes labialis is an infection that is caused by herpes simplex virus type 1 (HSV-1). It is characterized by an eruption of small, painful blisters on the skin of the lips, mouth, gums, tongue, or the skin around the mouth. The blisters are commonly referred to as cold sores or fever blisters. Once the person is infected with this virus, it can lie latent in the cells for a period of time. The incubation period is about 2 to 12 days. Between 50% and 80% of Americans are infected by age 30 years, because HSV-1 is typically transmitted during childhood through nonsexual contact. Herpes labialis is extremely contagious and can be spread through contaminated razors, towels, and dishes. It is activated by overexposure to sunlight or wind, colds, influenza and similar infections, heavy alcohol use, and physical or emotional stress.

Although herpes simplex virus type 2 (HSV-2) typically causes painful vesicular and ulcerative lesions in the genital and anal areas, HSV-1 may also cause genital herpes. Oral–genital contact can spread oral herpes to the genitals (and vice versa). People with active herpetic lesions should avoid oral sex. It is extremely important for patients to understand that the virus can be transmitted by asymptomatic people. Estimates suggest that 80% of people infected are asymptomatic.

Early symptoms of herpes labialis include burning, itching, and increased sensitivity or tingling sensation. These symptoms may occur several days before the appearance of lesions. The lesions appear as macules or papules, progressing to small blisters (vesicles) filled with clear, yellowish fluid. They are raised, red, and painful and can break and ooze. The lesions typically extend through the epidermis and penetrate into the underlying dermis, consistent with a partial-thickness wound. Eventually, yellow crusts slough to reveal pink, healing skin. Typically, the virus is no longer detectable in the lesion or wound 5 days after the vesicle has developed.

Medications used in the management of herpes labialis include acyclovir (Zovirax) and valacyclovir (Valtrex), which help to minimize the symptoms and the duration or length of flare-up. Acetaminophen/paracetamol may be given for analgesia. Topical anesthetics such as lidocaine (Xylocaine) can help in the control of discomfort. Occlusive dressings have been shown to speed the healing process. Not only do such dressings prevent desiccation and scab formation but they also maintain an aqueous wound environment rich in growth factors and matrix materials. However, occlusive dressings are not practical for lip and mucosal lesions. In this case, alternatives include occlusive ointments such as Herpecin-L or docosanol (Abreva).



Adapted from Salvaggio, M. R. (2014). Herpes simplex. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/218580-overview

(NSAIDs), such as aspirin or ibuprofen, relieve aches and pains. Antihistamines are used to relieve sneezing, rhinorrhea, and nasal congestion. Petroleum jelly can soothe irritated, chapped, and raw skin around the nares (National Institute of Allergy and Infectious Diseases, 2015).

Guaifenesin (Mucinex), an expectorant, is available without a prescription and is used to promote removal of secretions. Antimicrobial agents (antibiotics) should not be used, because they do not affect the virus or reduce the incidence of bacterial complications. In addition, their inappropriate use has been implicated in the development of organisms resistant to therapy.

Topical nasal decongestants (e.g., phenylephrine nasal [Neo-Synephrine] and oxymetazoline nasal [Afrin]) should be used with caution. Topical therapy delivers medication directly to the nasal mucosa, and its overuse can produce **rhinitis medicamentosa,** or rebound rhinitis. Most patients treat the common cold with OTC medications that produce moderate clinical benefits, such as relief of symptoms.

In addition, alternative medicines (e.g., echinacea, zinc lozenges, and zinc nasal spray) are frequently used to treat the common cold; however, evidence regarding their effectiveness in shortening the symptomatic phase is limited (Karsch-Volk, Barrett, Keifer, et al., 2014). The inhalation of steam or heated, humidified air has been a mainstay of home remedies to treat the common cold; however, the value of this therapy has not been demonstrated.

Nursing Management

Educating Patients about Self-Care

Most viruses can be transmitted in several ways: direct contact with infected secretions, inhalation of large particles from others' coughing or sneezing, or inhalation of small particles (aerosol) that may be suspended in the air for up to an hour. Implementation of appropriate hand hygiene measures (see Chart 1-4 for further information on hand hygiene methods) remains the most effective measure to prevent transmission of organisms. The nurse educates the patient about how to break the chain of infection with appropriate hand hygiene and the use of tissues to avoid the spread of the virus with coughing and sneezing, and to cough or sneeze into the upper arm if tissues are not readily available. The nurse instructs the patient about methods to treat symptoms of the common cold and provides both verbal and written information to assist in the prevention and management of URIs.

Rhinosinusitis

Rhinosinusitis, formerly called *sinusitis,* is an inflammation of the paranasal sinuses and nasal cavity. The American Academy of Otolaryngology–Head and Neck Surgery Foundation (Rosenfeld, Andes, Bhattacharyya, et al., 2015) recommends the use of the term *rhinosinusitis* because sinusitis is almost always accompanied by inflammation of the nasal mucosa. Around 134 million Indians suffer from chronic sinusitis annually which is more than those who suffer from coronary artery disease, diabetes, or asthma (Khanna & Gharpure, 2012) Uncomplicated rhinosinusitis occurs without extension of inflammation outside of the paranasal sinuses and nasal cavity. Rhinosinusitis is classified by duration of symptoms as acute (less than 4 weeks), subacute (4 to 12 weeks), and chronic (more than 12 weeks). Rhinosinusitis can be caused by a bacterial or viral infection.

Acute Rhinosinusitis

Acute rhinosinusitis is classified as acute bacterial rhinosinusitis (ABRS) or acute viral rhinosinusitis (AVRS). Recurrent acute rhinosinusitis is characterized by four or more acute episodes of ABRS per year (Rosenfeld et al., 2015) and is discussed with chronic rhinosinusitis (CRS).

Pathophysiology

Acute rhinosinusitis usually follows a viral URI or cold, such as an unresolved viral or bacterial infection, or an exacerbation of allergic rhinitis. Normally, the sinus openings into the nasal passages are clear and infections resolve promptly. However, if their drainage is obstructed by a deviated septum or by hypertrophied turbinates, spurs, or nasal polyps or tumors, sinus infection may persist as a smoldering (persistent) secondary infection or progress to an acute suppurative process (causing purulent discharge).

Nasal congestion, caused by inflammation, edema, and transudation of fluid secondary to URI, leads to obstruction of the sinus cavities (see Fig. 40-1). This provides an excellent medium for bacterial growth. Other conditions and activities that can block the normal flow of sinus secretions include abnormal structures of the nose, enlarged adenoids, diving and swimming, tooth infection, trauma to the nose, tumors, and the pressure of foreign objects. Some people are more prone to rhinosinusitis because exposure to environmental hazards such as paint, sawdust, and chemicals may result in chronic inflammation of the nasal passages.

Bacterial organisms account for more than 60% of the cases of acute rhinosinusitis. Typical pathogens include *Streptococcus pneumoniae, Haemophilus influenzae,* and less commonly *Staphylococcus aureus,* and *Moraxella catarrhalis* (Brook, 2015). Biofilms, which consist of organized, heterogeneous communities of bacteria, have been found to be 10 to 1000 times more resistant to antibiotic treatment and more likely to contribute to host resistance when compared with other bacteria. They serve as bacterial reservoirs that can cause systemic illness when released into the circulation. Although antibiotics kill bacteria in the biofilm margin, cells deep in the biofilm are not affected, allowing for regrowth once antibiotic therapy has been discontinued. Pathogens in the upper respiratory tract that form biofilms include those species listed earlier as well as *Pseudomonas aeruginosa.*

Other organisms that are occasionally isolated include *Chlamydia pneumoniae, Streptococcus pyogenes,* viruses, and fungi (*Aspergillus fumigatus*). Fungal infections occur most often in immunosuppressed patients (Brook, 2015).

Clinical Manifestations

Symptoms of ABRS include purulent nasal drainage (anterior, posterior, or both) accompanied by nasal obstruction or a combination of facial pain, pressure, or a sense of fullness (referred to collectively as facial pain–pressure–fullness), or both (Rosenfeld et al., 2015). The facial pain–pressure–fullness may involve the anterior face or the periorbital region. The patient may also report cloudy or colored nasal discharge congestion, blockage, or stuffiness as well as a localized or diffuse headache. Patients with ABRS may present with a high fever (i.e., 39°C [102°F] or higher). In addition, the occurrence of symptoms for 10 days or more after the initial onset of upper respiratory symptoms indicates ABRS (Brook, 2015).

The symptoms of AVRS are similar to those of ABRS, except the patient does not present with a high fever, nor with the same

intensity of symptoms (e.g., there tends to be an absence of facial pain–pressure–fullness), nor with symptoms that persist for as long a period of time. Symptoms of AVRS occur for fewer than 10 days after the onset of upper respiratory symptoms and do not worsen (Tierney, McPhee, & Papadakis, 2015).

Assessment and Diagnostic Findings

A careful history and physical examination are performed. The head and neck, particularly the nose, ears, teeth, sinuses, pharynx, and chest, are examined. There may be tenderness to palpation over the infected sinus area. The sinuses are percussed using the index finger, tapping lightly to determine whether the patient experiences pain. Although less frequently performed, transillumination of the affected area may reveal a decrease in the transmission of light with rhinosinusitis (see Chapter 10). Diagnostic imaging (x-ray, computed tomography [CT], magnetic resonance imaging [MRI]) is not recommended and generally not needed for the diagnosis of acute rhinosinusitis if the patient meets clinical diagnostic criteria (Rosenfeld et al., 2015). When a complication or alternative diagnosis is suspected, CT scans may be indicated because these scans are sensitive to inflammatory changes and bone destruction and identify anatomic variations that can guide sinus surgery if indicated.

To confirm the diagnosis of maxillary and frontal rhinosinusitis and identify the pathogen, sinus aspirates may be obtained. Flexible endoscopic culture techniques and swabbing of the sinuses have been used for this purpose (Krouse & Krouse, 2015).

Complications

If untreated, acute rhinosinusitis may lead to severe complications. Local complications include osteomyelitis and mucocele (cyst of the paranasal sinuses). Osteomyelitis requires prolonged antibiotic therapy and at times removal of necrotic bone. Intracranial complications, although rare, include cavernous sinus thrombosis, meningitis, brain abscess, ischemic brain infarction, and severe orbital cellulitis (Tierney et al., 2015). Mucoceles may require surgical treatment to establish intranasal drainage or complete excision with ablation of the sinus cavity. Brain abscesses occur by direct spread and can be life threatening. Frontal epidural abscesses are usually quiescent but can be detected by CT scan.

Medical Management

Treatment of acute rhinosinusitis depends on the cause; a 5- to 7-day course of antibiotics is prescribed for bacterial cases (Tewfik, 2015). The goals of treatment for acute rhinosinusitis are to shrink the nasal mucosa, relieve pain, and treat infection. Because of the inappropriate use of antibiotics for nonbacterial illness, including AVRS, and the resulting resistance that has occurred, oral antibiotics are only prescribed when there is sufficient empiric evidence that the patient has ABRS (e.g., high fever or symptoms that persist for at least 10 days or worsening symptoms following a viral respiratory illness).

Antibiotics should be given as soon as the diagnosis of ABRS is established. Amoxicillin–clavulanic acid (Augmentin) is the antibiotic of choice. For patients who are allergic to penicillin, doxycycline (Vibramycin) or respiratory quinolones such as levofloxacin (Levaquin) or moxifloxacin (Avelox) can be used. Other antibiotics prescribed previously to treat ABRS, including cephalosporins such as cephalexin (Keflex), cefuroxime (Ceftin), cefaclor (Ceclor), and cefixime (Suprax), trimethoprim–sulfamethoxazole (Bactrim, Septra), and macrolides such as clarithromycin (Biaxin) and azithromycin (Zithromax), are no longer recommended because they are not effective in treating antibiotic-resistant organisms that are now more commonly implicated in ABRS (Tewfik, 2015). Intranasal saline lavage is an effective adjunct therapy to antibiotics in that it may relieve symptoms, reduce inflammation, and help clear the passages of stagnant mucus. Neither decongestants nor antihistamines are recommended adjunctive medications for treating ABRS (Tewfik, 2015).

Treatment of AVRS typically involves nasal saline lavage and decongestants (guaifenesin/pseudoephedrine [Entex PSE]). Decongestants or nasal saline sprays can increase patency of the ostiomeatal unit and improve drainage of the sinuses. Topical decongestants should not be used for longer than 3 or 4 days. Oral decongestants must be used cautiously in patients with hypertension. OTC antihistamines, such as diphenhydramine (Benadryl) and cetirizine (Zyrtec), and prescription antihistamines, such as fexofenadine (Allegra), are used if an allergic component is suspected.

Intranasal corticosteroids have been shown to produce complete or marked improvement in acute symptoms of either bacterial or viral rhinosinusitis; however, they are only recommended for use in patients with a previous history of allergic rhinitis (Krouse & Krouse, 2014); (Rosenfeld et al., 2015). Examples of intranasal corticosteroids, side effects, and contraindications are presented in Table 40-2.

Nursing Management

Educating Patients About Self-Care

Patient education is an important aspect of nursing care for the patient with acute rhinosinusitis. The nurse instructs the patient about symptoms of complications that require immediate follow-up. Referral to the primary provider is indicated if periorbital edema and severe pain on palpation occur. The nurse instructs the patient about methods to promote drainage of the sinuses, including humidification of the air in the home

TABLE 40-2 Selected Nasal Corticosteroids and Common Side Effects

Nasal Corticosteroids	Side Effects	Contraindications (for all Nasal Corticosteroids)
Beclomethasone (Beconase AQ)	Nasal irritation, headache, nausea, lightheadedness, epistaxis, rhinorrhea, watering eyes, sneezing, dry nose and throat	Avoid in patients with recurrent epistaxis, glaucoma, and cataracts. Patients who have been exposed to measles/varicella or who have adrenal insufficiency should avoid these medications.
Budesonide (Rhinocort)	Epistaxis, pharyngitis, cough, nasal irritation, bronchospasm	
Mometasone (Nasonex)	Headache, viral infection, pharyngitis, epistaxis, cough, dysmenorrhea, musculoskeletal pain, arthralgia	
Triamcinolone (Nasacort AQ)	Pharyngitis, epistaxis, cough, headache	

Adapted from Peters, A. (2015). Rhinosinusitis: Synopsis. Retrieved on 10/8/2015 at: www.worldallergy.org/professional/allergic_diseases_center/rhinosinusitis/sinusitissynopsis.php

and the use of warm compresses to relieve pressure. The patient is advised to avoid swimming, diving, and air travel during the acute infection. Patients using tobacco are instructed to immediately stop smoking or using any form of tobacco. Most patients use nasal sprays incorrectly, which can lead to several side effects that include nasal irritation, nasal burning, bad taste, and drainage in the throat or even epistaxis. Therefore, if an intranasal corticosteroid is prescribed, it is important to instruct the patient about the correct use of prescribed nasal sprays through demonstration, explanation, and return demonstration to evaluate the patient's understanding of the correct method of administration. The nurse also educates the patient about the side effects of prescribed and OTC nasal sprays and about rebound congestion (rhinitis medicamentosa). Once the decongestant is discontinued, the nasal passages close and congestion results. Appropriate medications to use for pain relief include acetaminophen/paracetamol (Tylenol) and NSAIDs such as ibuprofen (Advil), naproxen sodium (Aleve), and aspirin for adults older than 20 years.

The nurse tells patients with recurrent rhinosinusitis to begin decongestants, such as pseudoephedrine (Sudafed), at the first sign of rhinosinusitis. This promotes drainage and decreases the risk of bacterial infection. Patients should also check with their primary provider or pharmacist before using OTC medications because many cold medications can worsen symptoms or other health problems, specifically hypertension.

The nurse stresses the importance of following the recommended antibiotic regimen because a consistent blood level of the medication is critical to treat the infection. The nurse educates the patient about the early signs of a sinus infection and recommends preventive measures such as following healthy practices and avoiding contact with people with URIs.

The nurse explains to the patient that fever, severe headache, and nuchal rigidity (stiffness of the neck or inability to bend the neck) are signs of potential complications. Patients with chronic symptoms of rhinosinusitis who do not have marked improvement in 4 weeks with continuous medical treatment may be candidates for functional endoscopic sinus surgery (FESS, see later discussion) (Krings, Kallogjeri, Wineland, et al., 2014).

Nursing Alert: Patients with nasotracheal and nasogastric tubes in place are at the risk for development of sinus infections. Thus, accurate assessment of patients with these tubes is critical. Removal of the nasotracheal or nasogastric tube as soon as the patient's condition permits allows the sinuses to drain, possibly avoiding septic complications.

Chronic Rhinosinusitis and Recurrent Acute Rhinosinusitis

Chronic rhinosinusitis is one of the common causes of visit to the ENT outpatient department (OPD) in India. According to a large-scale study done in Uttar Pradesh, chronic rhinosinusitis was the most common form with a prevalence of 46.1% followed by acute rhinosinusitis (Khan & Siddiqui, 2020). It is defined as the inflammation of the nose and paranasal sinuses with 12 weeks or longer duration with any two or more of the following symptoms: mucopurulent drainage, nasal obstruction, facial pain–pressure–fullness, or hyposmia (decreased sense of smell). It is estimated that in about 40% of patients, CRS is accompanied by nasal polyps (Rosenfeld et al., 2015). Recurrent acute rhinosinusitis is diagnosed when four or more episodes of ABRS occur per year with no signs or symptoms of rhinosinusitis between the episodes. The use of antibiotics in patients with recurrent acute rhinosinusitis is higher than in patients with CRS. Both CRS and recurrent acute rhinosinusitis affect quality of life as well as physical and social function (Rosenfeld et al., 2015).

Pathophysiology

Mechanical obstruction in the ostia of the frontal, maxillary, and anterior ethmoid sinuses (known collectively as the ostiomeatal complex) is the usual cause of CRS and recurrent acute rhinosinusitis. Obstruction prevents adequate drainage of the nasal passages, resulting in accumulation of secretions and an ideal medium for bacterial growth. Persistent blockage in an adult may occur because of infection, allergy, or structural abnormalities. Other associated conditions and factors may include cystic fibrosis, ciliary dyskinesia, neoplastic disorders, gastroesophageal reflux disease, tobacco use, and environmental pollution (Rosenfeld et al., 2015).

Both aerobic and anaerobic bacteria have been implicated in CRS and recurrent rhinosinusitis. Common aerobic bacteria include alpha-hemolytic streptococci, microaerophilic streptococci, and *S. aureus.* Common anaerobic bacteria include gram-negative bacilli, *Peptostreptococcus,* and *Fusobacterium.*

In addition, immunodeficiency should be considered in patients with CRS or acute recurrent rhinosinusitis. Acute fulminant/invasive rhinosinusitis is a life-threatening illness and is commonly attributed to *Aspergillus* in immunocompromised patients. Chronic fungal sinusitis also poses a risk. Chronic invasive fungal sinusitis occurs in immunocompromised patients along with fungus ball/mycetoma and allergic fungal sinusitis—the more common forms of chronic fungal sinusitis—which are considered noninvasive conditions in immunocompromised patients. The fungus ball is characterized by the presence of a noninvasive accumulation of a dense conglomeration of fungal hyphae in one sinus cavity, usually the maxillary sinus. The fungus generally remains contained in the fungus ball, which consists of mucopurulent cheesy or claylike materials within the sinus, but can become invasive when immunosuppression occurs, leading to encephalopathy (Lal, 2015). Symptoms include nasal stuffiness, nasal discharge, and facial pain. Vision loss, headache, and cranial nerve palsies have been identified in patients with a sphenoid sinus fungal ball (Lal, 2015).

Clinical Manifestations

Clinical manifestations of CRS include impaired mucociliary clearance and ventilation, cough (because the thick discharge constantly drips backward into the nasopharynx), chronic hoarseness, chronic headaches in the periorbital area, periorbital edema, and facial pain. As a result of chronic nasal congestion, the patient is usually required to breathe through the mouth. Snoring, sore throat, and, in some situations, adenoidal hypertrophy may also occur. Symptoms are generally most pronounced on awakening in the morning. Fatigue and nasal congestion are also common. Many patients experience a decrease in smell and taste and a sense of fullness in the ears.

Assessment and Diagnostic Findings

The health assessment focuses on onset and duration of symptoms. It addresses the quantity and quality of nasal discharge and cough, the presence of pain, factors that relieve or aggravate the pain, and allergies. It is essential to obtain any history of comorbid conditions, including asthma and history of tobacco use. A history of fever, fatigue, previous episodes and treatments and previous response to therapies is also obtained.

In the physical assessment, the external nose is evaluated for any evidence of anatomic abnormality. A crooked-appearing external nose may imply septal deviation internally. The nasal mucous membranes are assessed for erythema, pallor, atrophy, edema, crusting, discharge, polyps, erosions, and septal perforations or deviations. Appropriate lighting improves visualization of the nasal cavity and should be used in every examination. Pain on examination of the teeth, with tapping with a tongue blade, suggests tooth infection (Bickley & Szilagyi, 2013).

Assessment of the posterior oropharynx may reveal purulent or mucoid discharge, which is indicative of an infection caused by CRS. The patient's eyes are examined for conjunctival erythema, tearing, photophobia, and edema of the lids. Additional assessment techniques include transillumination of the sinuses and palpation of the sinuses. The frontal and maxillary sinuses are palpated, and the patient is asked whether this produces tenderness. The pharynx is inspected for erythema and discharge and palpated for cervical node adenopathy (Rosenfeld et al., 2015).

Imaging studies such as x-ray, sinoscopy, ultrasound, CT scanning, and MRI may be used in the diagnosis of CRS. X-ray is an inexpensive and readily available tool to assess disorders of the paranasal sinuses. A CT scan of the paranasal sinuses can identify mucosal abnormalities, sinus ostial obstruction, anatomic variants, sinonasal polyposis, and neoplastic disease. In addition, nasal endoscopy allows for visualization of the posterior nasal cavity, nasopharynx, and sinus drainage pathways and can identify posterior septal deviation and polyps. Osseous destruction, extrasinus extension of the disease process, and local invasion suggest malignancy (Rosenfeld et al., 2015). (See Chapter 10 for further discussion of CT, MRI, and x-ray.)

Complications

Complications of CRS, although uncommon, include severe orbital cellulitis, subperiosteal abscess, cavernous sinus thrombosis, meningitis, encephalitis, and ischemic infarction. CRS can lead to intracranial infection either by direct spread through bone or via venous channels, resulting in epidural abscess, subdural empyema, meningitis, and brain abscess. Clinical sequelae can include personality changes with frontal lobe abscesses, headache, symptoms of elevated intracranial pressure to include alterations of consciousness, visual changes, focal neurologic deficits, seizures, and, ultimately, coma and death.

Frontal rhinosinusitis can lead to osteomyelitis of the frontal bones. Patients typically present with headache, fever, and a characteristic doughy edema over the involved bone. Ethmoid rhinosinusitis may result in orbital cellulitis, which usually begins with edema of the eyelids and rapidly progresses to ptosis (droopy eyelid), proptosis (bulging eye), chemosis (edema of the bulbar conjunctiva), and diminished extraocular movements. Patients are usually febrile and acutely ill and require immediate attention, because pressure on the optic nerve can lead to loss of vision and spread of infection can lead to intracranial infection. Cavernous sinus thrombophlebitis can result from extension of infection along venous channels from the orbit, ethmoid or frontal sinuses, or nose. Symptoms may include altered consciousness, lid edema, and proptosis, as well as third, fourth, and sixth cranial nerve palsies.

Medical Management

Medical management of CRS and recurrent acute rhinosinusitis is similar to that of acute rhinosinusitis. General measures include encouraging adequate hydration and recommending the use of OTC nasal saline sprays, analgesics such as acetaminophen/paracetamol or NSAIDs, and decongestants such as oxymetazoline and pseudoephedrine (Tewfik, 2015); (Brook, 2015). Patients are instructed to sleep with the head of the bed elevated and to avoid exposure to cigarette smoke and fumes. Patients are cautioned to avoid caffeine and alcohol, which can cause dehydration.

Prescribed antibiotics may include amoxicillin-clavulanic acid, erythromycin–sulfisoxazole (Eryzole), second- or third-generation cephalosporins such as cefuroxime or cefixime, or newer fluoroquinolones such as moxifloxacin (Avelox) (Brook, 2015). The course of antibiotic treatment for CRS and recurrent ABRS is typically as long as 2 to 4 weeks to effectively eradicate the offending organism, and may be indicated for up to 12 months in some cases (Brook, 2015). Corticosteroid nasal sprays such as fluticasone (Flonase) or beclomethasone (Beconase AQ) may be indicated in patients with concomitant allergic rhinitis or nasal polyps. Patients with allergic rhinitis may also benefit from the addition of a mast cell stabilizer such as cromolyn. For patients with concomitant asthma, leukotriene inhibitors such as montelukast and zafirlukast may be used (Brook, 2015).

Surgical Management

If standard medical therapy fails and symptoms persist, FESS may be indicated to correct structural deformities that obstruct the ostia (openings) of the sinuses. FESS is a minimally invasive surgical procedure that is associated with reduced postoperative discomfort and improvement in the patient's quality of life. In particular, FESS is associated with either complete or moderate relief of symptoms in more than 85% to 91% of patients (Patel, 2014). Some of the specific procedures performed include excising and cauterizing nasal polyps, correcting a deviated septum, incising and draining the sinuses, aerating the sinuses, and removing tumors. Antimicrobial agents may be given before and after surgery. Computer-assisted or computer-guided surgery is used to increase the precision of the surgical procedure and to minimize complications (Patel, 2014).

Surgical intervention may be required in acute invasive fungal rhinosinusitis to excise the fungus ball and necrotic tissue and drain the sinuses. Patients require aggressive surgical débridement and drainage as well as systemic antifungal medications.

Nursing Management

Patients usually perform care measures for rhinosinusitis at home; therefore, nursing management consists of good patient education.

Educating Patients about Self-Care

Many people with sinus infections tend to blow their nose frequently and with force to clear their nasal passages. Doing so often increases the symptoms; therefore, the patient is instructed to blow the nose gently and to use tissue to remove the nasal drainage. Increasing fluid intake, applying local heat (hot wet packs), and elevating the head of the bed promote drainage of the sinuses. The nurse also instructs the patient about the importance of following the prescribed medication regimen. Instructions on the early signs of a sinus infection are provided, and preventive measures are reviewed. The nurse instructs the patient about signs and symptoms that require follow-up and provides these instructions verbally and in writing. Instructions in alternate formats (e.g., large font, patient's language) may be needed to increase the patient's understanding and adherence to the treatment plan. The nurse encourages the patient to follow up with their primary provider if symptoms persist.

Nursing Alert: URIs, specifically CRS and recurrent acute rhinosinusitis, may be linked to primary or secondary immune deficiency or treatment with immunosuppressive therapy (e.g., for cancer or organ transplantation). Typical symptoms may be blunted or absent due to immunosuppression. Immunocompromised patients are at the increased risk for acute or chronic fungal infections; these infections can progress rapidly and become life threatening. Thus, assessment, early reporting of symptoms to the patient's primary provider and immediate initiation of treatment are essential.

Pharyngitis

Acute Pharyngitis

Acute pharyngitis is a sudden painful inflammation of the pharynx, the back portion of the throat that includes the posterior third of the tongue, soft palate, and tonsils. It is commonly referred to as a sore throat. Because of environmental exposure to viral agents and poorly ventilated rooms, the incidence of viral pharyngitis peaks during winter and early spring in regions that have warm summers and cold winters. Viral pharyngitis spreads easily in the droplets of coughs and sneezes, as well as from unclean hands that have been exposed to the contaminated fluids.

Pathophysiology

Viral infection causes most cases of acute pharyngitis. Responsible viruses include the adenovirus, influenza virus, Epstein–Barr virus, and herpes simplex virus. Bacterial infection accounts for the remainder of cases. Ten percent of adults with pharyngitis have group A beta-hemolytic streptococcus (GABHS), which is commonly referred to as group A streptococcus (GAS) or streptococcal pharyngitis. Streptococcal pharyngitis warrants the use of antibiotic treatment. When GAS causes acute pharyngitis, the condition is known as strep throat. The body responds by triggering an inflammatory response in the pharynx. This results in pain, fever, vasodilation, edema, and tissue damage, manifested by redness and swelling in the tonsillar pillars, uvula, and soft palate. A creamy exudate may be present in the tonsillar pillars (see Fig. 40-2). Other bacterial organisms implicated in acute pharyngitis include groups B and G streptococci, *Neisseria gonorrhoeae, Mycoplasma pneumoniae, C. pneumoniae, Arcanobacterium haemolyticum,* and HIV (Randel, 2013).

Uncomplicated viral infections usually subside promptly, within 3 to 10 days after onset. However, pharyngitis caused by more virulent bacteria, such as GAS, is a more severe illness. If left untreated, the complications can be severe and life threatening. Complications include rhinosinusitis, otitis media, peritonsillar abscess, mastoiditis, and cervical adenitis. In rare cases, the infection may lead to bacteremia, pneumonia, meningitis, rheumatic fever, and nephritis.

Clinical Manifestations

The signs and symptoms of acute pharyngitis include a fiery-red pharyngeal membrane and tonsils, lymphoid follicles that are swollen and flecked with white-purple exudate, enlarged and tender cervical lymph nodes, and no cough. Fever (higher than 38.3°C [101°F]), malaise, and sore throat also may be present. Occasionally, patients with GAS pharyngitis exhibit vomiting, anorexia, and a scarlatina-form rash with urticaria known as scarlet fever.

People who have streptococcal pharyngitis suddenly develop a painful sore throat 1 to 5 days after being exposed to the streptococcus bacteria. They usually report malaise, fever (with or without chills), headache, myalgia, painful cervical adenopathy, and nausea. The tonsils appear swollen and erythematous, and they may or may not have an exudate. The roof of the mouth is often erythematous and may demonstrate petechiae. Bad breath is common.

Assessment and Diagnostic Findings

Accurate diagnosis of pharyngitis is essential to determine the cause (viral or bacterial) and to initiate treatment early. Rapid antigen detection testing (RADT) uses swabs that collect specimens from the posterior pharynx and tonsil. RADT is reported to be 90% to 95% sensitive, thus facilitating earlier treatment and earlier symptom improvement and reductions in pathogen transmission. Negative results should be confirmed by a throat culture (Randel, 2013). In most communities, preliminary culture reports are available in 24 hours. Once a definitive diagnosis of GAS is made, administration of appropriate antibiotics hastens symptom resolution and reduces the transmission of the illness.

Medical Management

Viral pharyngitis is treated with supportive measures because antibiotics have no effect on the causal organism. Bacterial pharyngitis is treated with a variety of antimicrobial agents.

Pharmacologic Therapy

If the cause of pharyngitis is bacterial, penicillin is usually the treatment of choice. Penicillin V potassium given orally for 5 days is the regimen of choice. Penicillin injections are recommended only if there is a concern that the patient will not adhere to therapy (Tierney et al., 2015).

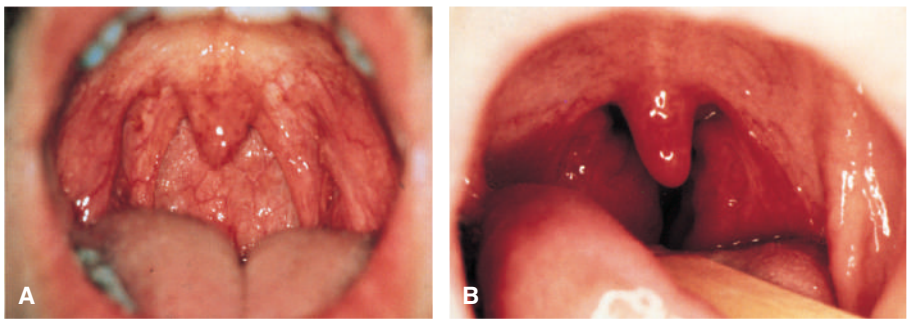


Figure 40-2 • Pharyngitis—inflammation without exudate. **A.** Redness and vascularity of the pillars and uvula are mild to moderate. **B.** Redness is diffuse and intense. Each patient would probably complain of a sore throat. From the Wellcome Trust, National Medical Slide Bank, London, UK.

For patients who are allergic to penicillin or have organisms that are resistant to erythromycin (one fifth of GAS and most *S. aureus* organisms are resistant to penicillin and erythromycin), cephalosporins and macrolides (clarithromycin and azithromycin) may be used. Once-daily azithromycin may be given for only 3 days due to its long half-life (Tierney et al., 2015). A 5- or 10-day course of cephalosporin may be prescribed. Five-day administration of cefpodoxime and cefuroxime has also been successful in producing bacteriologic cures.

Severe sore throats can also be relieved by analgesic medications, as prescribed. For example, aspirin or acetaminophen/paracetamol can be taken at 4- to 6-hour intervals; if required, acetaminophen/paracetamol with codeine can be taken three or four times daily. In severe cases, gargles with benzocaine may relieve symptoms.

Nutritional Therapy

A liquid or soft diet is provided during the acute stage of the disease, depending on the patient's appetite and the degree of discomfort that occurs with swallowing. Cool beverages, warm liquids, and flavored frozen desserts such as ice pops are often soothing. Occasionally, the throat is so sore that liquids cannot be taken in adequate amounts by mouth. In severe situations, intravenous (IV) fluids may be needed. Otherwise, the patient is encouraged to drink as much fluid as possible (at least 2 to 3 L/day).

Nursing Management

Nursing care for patients with viral pharyngitis focuses on symptomatic management. For patients who demonstrate signs of strep throat and have a history of rheumatic fever, who have scarlet fever, or who have symptoms suggesting peritonsillar abscess, nursing care focuses on prompt initiation and correct administration of prescribed antibiotic therapy. The nurse instructs the patient about signs and symptoms that warrant prompt contact with the primary provider. These include dyspnea, drooling, inability to swallow, and inability to fully open the mouth.

The nurse instructs the patient to stay in bed during the febrile stage of illness and to rest frequently once up and about. Used tissues should be disposed of properly to prevent the spread of infection. The nurse (or the patient or family member, if the patient is not hospitalized) should examine the skin once or twice daily for possible rash, because acute pharyngitis may precede some other communicable diseases (e.g., rubella).

Depending on the severity of the pharyngitis and the degree of pain, warm saline gargles or throat irrigations are used. The benefits of this treatment depend on the degree of heat that is applied. The nurse educates the patient about these procedures and about the recommended temperature of the solution, which should be high enough to be effective and as warm as the patient can tolerate, usually 40.6°C to 43.3°C (105°F to 110°F). Irrigating the throat may reduce spasm in the pharyngeal muscles and relieve soreness of the throat.

An ice collar also can relieve severe sore throats. Mouth care may promote the patient's comfort and prevent the development of fissures (cracking) of the lips and oral inflammation when bacterial infection is present. The nurse instructs the patient to resume activity gradually and to delay returning to work or school until after 24 hours of antibiotic therapy. A full course of antibiotic therapy is indicated in patients with strep infection because of the potential complications such as nephritis and rheumatic fever, which may have their onset 2 or 3 weeks after the pharyngitis has subsided. The nurse instructs the patient and family about the importance of taking the full course of therapy and informs them about the symptoms to watch for that may indicate complications.

In addition, the nurse instructs the patient about preventive measures that include not sharing eating utensils, glasses, napkins, food, or towels; cleaning telephones after use; using a tissue to cough or sneeze; disposing of used tissues appropriately; coughing or sneezing into the upper arm if tissues are not readily available; and avoiding exposure to tobacco and secondhand smoke. The nurse also instructs the patient with pharyngitis, especially streptococcal pharyngitis, to replace their toothbrush with a new one.

Chronic Pharyngitis

Chronic pharyngitis is a persistent inflammation of the pharynx. It is common in adults who work in dusty surroundings, use their voice to excess, suffer from chronic cough, or habitually use alcohol and tobacco.

There are three types of chronic pharyngitis:

- **Hypertrophic**—characterized by general thickening and congestion of the pharyngeal mucous membrane
- **Atrophic**—probably a late stage of the first type (the membrane is thin, whitish, glistening, and at times wrinkled)
- **Chronic granular**—characterized by numerous swollen lymph follicles on the pharyngeal wall

Clinical Manifestations

Patients with chronic pharyngitis complain of a constant sense of irritation or fullness in the throat, mucus that collects in the throat and can be expelled by coughing, and difficulty swallowing. This is often associated with intermittent postnasal drip that causes minor irritation and inflammation of the pharynx. A sore throat that is worse with swallowing in the absence of pharyngitis suggests the possibility of thyroiditis, and patients with this symptom are referred for the evaluation of possible thyroiditis.

Medical Management

Treatment of chronic pharyngitis is based on relieving symptoms; avoiding exposure to irritants; and correcting any upper respiratory, pulmonary, gastrointestinal, or cardiac condition that might be responsible for a chronic cough.

Nasal congestion may be relieved by short-term use of nasal sprays or medications containing ephedrine sulfate or phenylephrine. For a patient with a history of allergy, one of the antihistamine decongestant medications, such as pseudoephedrine or brompheniramine/pseudoephedrine, is prescribed orally every 4 to 6 hours. Aspirin (for patients older than 20 years) or acetaminophen/paracetamol is recommended for its analgesic properties.

For adults with chronic pharyngitis, tonsillectomy may be an effective option. For further information, see the Tonsillitis and Adenoiditis section.

Nursing Management

Educating Patients about Self-Care

The nurse recommends avoidance of alcohol, tobacco, secondhand smoke, and exposure to cold or to environmental or occupational pollutants. The patient may minimize exposure to pollutants by wearing a disposable facemask. The nurse encourages the patient to drink plenty of fluids. Gargling with warm saline solution may relieve throat discomfort. Lozenges keep the throat moistened.

Tonsillitis and Adenoiditis

The tonsils are composed of lymphatic tissue and are situated on each side of the oropharynx. The faucial or palatine tonsils and lingual tonsils are located behind the pillars of fauces and tongue, respectively. They frequently serve as the site of acute infection (tonsillitis). Acute tonsillitis can be confused with pharyngitis. Chronic tonsillitis is less common and may be mistaken for other disorders such as allergy, asthma, and rhinosinusitis.

The adenoids or pharyngeal tonsils consist of lymphatic tissue near the center of the posterior wall of the nasopharynx. Infection of the adenoids frequently accompanies acute tonsillitis. Frequently occurring bacterial pathogens include GABHS, the most common organism. The most common viral pathogen is Epstein–Barr virus, although cytomegalovirus may also cause tonsillitis and adenoiditis. Often thought of as a childhood disorder, tonsillitis can occur in adults.

Clinical Manifestations

The symptoms of tonsillitis include sore throat, fever, snoring, and difficulty swallowing. Enlarged adenoids may cause mouth breathing, earache, draining ears, frequent head colds, bronchitis, foul-smelling breath, voice impairment, and noisy respiration. Unusually enlarged adenoids fill the space behind the posterior nares, making it difficult for the air to travel from the nose to the throat and resulting in nasal obstruction. Infection can extend to the middle ears by way of the auditory (eustachian) tubes and may result in acute otitis media, which can lead to spontaneous rupture of the tympanic membranes (eardrums) and further extension of the infection into the mastoid cells, causing acute mastoiditis. The infection also may reside in the middle ear as a chronic, low-grade, smoldering process that eventually may cause permanent deafness.

Assessment and Diagnostic Findings

The diagnosis of acute tonsillitis is primarily clinical, with attention given to whether the illness is viral or bacterial in nature. As in acute pharyngitis, RADT is quick and convenient; however, it is less sensitive than the throat swab culture.

A thorough physical examination is performed and a careful history is obtained to rule out related or systemic conditions. The tonsillar site is cultured to determine the presence of bacterial infection. When cytomegalovirus infection is present, the differential diagnosis should include HIV, hepatitis A, and rubella. In adenoiditis, if recurrent episodes of suppurative otitis media result in hearing loss, comprehensive audiometric assessment is warranted (see Chapter 41).

Medical Management

Tonsillitis is treated with supportive measures that include increased fluid intake, analgesics, salt-water gargles, and rest. Bacterial infections are treated with penicillin (first-line therapy) or cephalosporins. Viral tonsillitis is not effectively treated with antibiotic therapy.

Tonsillectomy (with or without adenoidectomy) continues to be a commonly performed surgical procedure and remains the treatment of choice for patients with chronic tonsillitis (Shah, 2015). Adults who have undergone a tonsillectomy to treat recurrent streptococcal infections experience a decrease in the number of episodes of streptococcal or other throat infections or days with throat pain.

Tonsillectomy is indicated if the patient has had repeated episodes of tonsillitis despite antibiotic therapy; hypertrophy of the tonsils and adenoids that could cause obstruction and obstructive sleep apnea (OSA); repeated attacks of purulent otitis media; and suspected hearing loss due to serous otitis media that has occurred in association with enlarged tonsils and adenoids. Indications for adenoidectomy include chronic nasal airway obstruction, chronic rhinorrhea, obstruction of the eustachian tube with related ear infections, and abnormal speech. Surgery is also indicated if the patient has developed a peritonsillar abscess that occludes the pharynx, making swallowing difficult and endangering the patency of the airway (particularly during sleep). The presence of persistent tonsillar asymmetry should prompt an excisional biopsy to rule out lymphoma (Tierney et al., 2015). Antibiotic therapy may be initiated for patients undergoing tonsillectomy or adenoidectomy. Therapy may include oral penicillin or a cephalosporin (e.g., cefdinir [Omnicef] or moxifloxacin).

Nursing Management

Providing Postoperative Care

Continuous nursing observation is required in the immediate postoperative and recovery periods because of the risk of hemorrhage, which may also compromise the patient's airway (Seshamani, Vogtmann, Gattwood, et al., 2014). In the immediate postoperative period, the most comfortable position is prone, with the patient's head turned to the side to allow drainage from the mouth and pharynx. The nurse must not remove the oral airway until the patient's gag and swallowing reflexes have returned. The nurse applies an ice collar to the neck, and a basin and tissues are provided for the expectoration of blood and mucus.

Symptoms of postoperative complications include fever, throat pain, ear pain, and bleeding. Pain can be effectively controlled with analgesic medications. Postoperative bleeding may be seen as bright red blood if the patient expectorates it before swallowing it. If the patient swallows the blood, it becomes brown because of the action of the acidic gastric juice. If the patient vomits large amounts of dark blood or bright-red blood at frequent intervals, or if the pulse rate and temperature rise and the patient is restless, the nurse notifies the surgeon immediately. The nurse should have the following items ready for the examination of the surgical site for bleeding: a light, a mirror, gauze, curved hemostats, and a waste basin.

Occasionally, suture or ligation of a bleeding vessel is required. In such cases, the patient is taken to the operating room and given general anesthesia. After ligation, continuous nursing observation and postoperative care are required, as in the initial postoperative period. If there is no bleeding, water and ice chips may be given to the patient as soon as desired. The patient is instructed to refrain from too much talking and coughing, because these activities can produce throat pain. (See Chapter 6 for further discussion of postoperative nursing care.)

Educating Patients About Self-Care

Tonsillectomy and adenoidectomy are usually performed as outpatient surgery, and the patient is sent home from the recovery room once awake, oriented, and able to drink liquids and void. The patient and family must understand the signs and symptoms of hemorrhage. Bleeding may occur up to 8 days after surgery. The nurse instructs the patient about the use of liquid acetaminophen/paracetamol with or without codeine for pain control and explains that the pain will subside during the

first 3 to 5 days. The nurse informs the patient about the need to take the full course of any prescribed antibiotic for the first postoperative week (Drake & Carr, 2015).

Alkaline mouthwashes and warm saline solutions are useful in coping with the thick mucus and halitosis that may be present after surgery. The nurse should explain to the patient that a sore throat, stiff neck, minor ear pain, and vomiting may occur in the first 24 hours. The patient should eat an adequate diet with soft foods, which are more easily swallowed than hard foods. The patient should avoid spicy, hot, acidic, or rough foods. Milk and milk products (ice cream and yogurt) may be restricted because they make removal of mucus more difficult for some patients. The nurse instructs the patient about the need to maintain good hydration. The patient is advised to avoid vigorous tooth brushing or gargling because these activities can cause bleeding. The nurse encourages the use of a cool-mist vaporizer or humidifier in the home postoperatively. The patient should avoid smoking and heavy lifting or exertion for 10 days.

Peritonsillar Abscess

Peritonsillar abscess (also called *quinsy*) is the most common major suppurative complication of sore throat accounting for roughly 30% of soft tissue head and neck abscesses. It most commonly afflicts adults between the ages of 20 to 40 years, with the incidence roughly the same between men and women (Flores, 2015). This collection of purulent exudate between the tonsillar capsule and the surrounding tissues, including the soft palate, may develop after an acute tonsillar infection that progresses to a local cellulitis and abscess. Several bacteria are typically implicated in the pathogenesis of these abscesses, including *S. pyogenes, S. aureus, Neisseria* species, and *Corynebacterium* species (Flores, 2015); (Shah, 2015). In more severe cases, the infection can spread over the palate and to the neck and chest. Edema can cause airway obstruction, which can be a life threatening medical emergency. Peritonsillar abscess can be life threatening with mediastinitis, intracranial abscess, and empyema resulting from spread of infection. Early detection and aggressive management are essential (Flores, 2015).

Clinical Manifestations

The patient with a peritonsillar abscess is acutely ill with a severe sore throat, fever, trismus (inability to open the mouth), and drooling. Inflammation of the medial pterygoid muscle that lies lateral to the tonsil results in spasm, severe pain, and difficulty in opening the mouth fully. The pain may be so intense that the patient has difficulty swallowing saliva. The patient's breath often smells rancid. Other symptoms include a raspy voice, odynophagia (a severe sensation of burning, squeezing pain while swallowing), dysphagia (difficulty swallowing), and otalgia (pain in the ear). Odynophagia is caused by the inflammation of the superior constrictor muscle of the pharynx that forms the lateral wall of the tonsil. This causes pain on lateral movement of the head. The patient may also have tender and enlarged cervical lymph nodes. Examination of the oropharynx reveals erythema of the anterior pillar and soft palate as well as a purulent tonsil on the side of the peritonsillar abscess. The tonsil is pushed inferomedially, and the uvula is shifted contralaterally (Flores, 2015).

Assessment and Diagnostic Findings

Emergency department (ED) physicians frequently are the providers who diagnose patients with peritonsillar abscesses. When this occurs in the ED setting, the ED physician decides whether aspiration—an invasive procedure—should be carried out based on the patient's clinical picture. Intraoral ultrasound and transcutaneous cervical ultrasound are used in the diagnosis of peritonsillar cellulitis and abscesses.

Medical Management

Antimicrobial agents and corticosteroid therapy are used for the treatment of peritonsillar abscess. Antibiotics (usually penicillin) are extremely effective in controlling the infection, and if they are prescribed early in the course of the disease, the abscess may resolve without needing to be incised. However, if the abscess does not resolve, treatment choices include needle aspiration, incision and drainage under local or general anesthesia, and drainage of the abscess with simultaneous tonsillectomy. Following needle aspiration (discussed later) intramuscular administration of clindamycin (Cleocin) can be used in the outpatient setting, thus reducing both antibiotic and hospital costs. The use of topical anesthetic agents and throat irrigations may be prescribed to promote comfort along with administration of prescribed analgesic agents.

Patients with complications require hospitalization for IV antibiotics, imaging studies, observation, and proper airway management. Rarely, the patient with a peritonsillar abscess presents with acute airway obstruction and requires immediate airway management. Procedures may include intubation, cricothyroidotomy, or tracheotomy (Flores, 2015).

Surgical Management

Needle aspiration may be preferred over a more extensive procedure due to its high efficacy, low cost, and patient tolerance. The mucous membrane over the swelling is first sprayed with a topical anesthetic and then injected with a local anesthetic. Single or repeated needle aspirations are performed to decompress the abscess. Alternatively, the abscess may be incised and drained. These procedures are performed best with the patient in the sitting position to make it easier to expectorate the pus and blood that accumulate in the pharynx. The patient experiences almost immediate relief. Incision and drainage is also an effective option but is more painful than needle aspiration.

Tonsillectomy is considered for patients who are poor candidates for needle aspiration or incision and drainage. The risk of hemorrhage following tonsillectomy to treat peritonsillar abscess is higher than that of elective tonsillectomy and may be due to the patient's previous use of aspirin for pain relief.

Nursing Management

If the patient requires intubation, cricothyroidotomy, or tracheotomy to treat airway obstruction, the nurse assists with the procedure and provides support to the patient before, during, and after the procedure. The nurse also assists with the needle aspiration when indicated.

The nurse encourages the patient to use prescribed topical anesthetic agents and assists with throat irrigations or the frequent use of mouthwashes or gargles, using saline or alkaline solutions at a temperature of 40.6°C to 43.3°C (105°F to 110°F). Gentle gargling after the procedure with a cool normal saline gargle may relieve discomfort. The patient must be upright and clearly expectorate forward. The nurse instructs the patient to gargle *gently* at intervals of 1 or 2 hours for 24 to 36 hours. Liquids that are cool or at room temperature are usually well tolerated. Adequate fluids must be provided to treat dehydration and prevent its recurrence.

The nurse also observes the patient for complications and instructs the patient about signs and symptoms of complications that require prompt attention by the patient's primary provider. At discharge, the nurse provides verbal and written instructions regarding foods to avoid, when to return to work, and the need to refrain from or cease smoking. The need for continuation of good oral hygiene is also reinforced.

Laryngitis

Laryngitis, an inflammation of the larynx, often occurs as a result of voice abuse or exposure to dust, chemicals, smoke, and other pollutants or as part of a URI. It also may be caused by isolated infection involving only the vocal cords. Laryngitis is also associated with gastroesophageal reflux (referred to as reflux laryngitis).

Laryngitis is very often caused by the pathogens that cause the common cold and pharyngitis; the most common cause is a virus, and laryngitis is often associated with allergic rhinitis or pharyngitis. Bacterial invasion may be secondary. The onset of infection may be associated with exposure to sudden temperature changes, dietary deficiencies, malnutrition, or an immunosuppressed state. Viral laryngitis is common in the winter and is easily transmitted to others.

Clinical Manifestations

Signs of acute laryngitis include hoarseness or aphonia (loss of voice) and severe cough. Chronic laryngitis is marked by persistent hoarseness. Other signs of acute laryngitis include sudden onset made worse by cold dry wind. The throat feels worse in the morning and improves when the patient is indoors in a warmer climate. At times, the patient presents with a dry cough and a dry, sore throat that worsens in the evening hours. If allergies are present, the uvula will be visibly edematous. Many patients also complain of a "tickle" in the throat that is made worse by cold air or cold liquids.

Medical Management

Management of acute laryngitis includes resting the voice, avoiding irritants (including smoking), resting, and inhaling cool steam or an aerosol. If the laryngitis is part of a more extensive respiratory infection caused by a bacterial organism or if it is severe, appropriate antibacterial therapy is instituted. The majority of patients recover with conservative treatment; however, laryngitis tends to be more severe in older adult patients and may be complicated by pneumonia.

For chronic laryngitis, the treatment includes resting the voice, eliminating any primary respiratory tract infection, eliminating smoking, and avoiding secondhand smoke. Corticosteroids, such as beclomethasone, may be given. These preparations have few systemic or long-lasting effects and may reduce local inflammatory reactions. Treatment of reflux laryngitis typically involves use of proton pump inhibitors such as omeprazole (Prilosec) given once daily.

Nursing Management

The nurse instructs the patient to rest the voice and to maintain a well-humidified environment. If laryngeal secretions are present during acute episodes, expectorant agents are suggested, along with a daily fluid intake of 2 to 3 L to thin secretions. The nurse instructs the patient about the importance of taking prescribed medications, including proton pump inhibitors, and using continuous positive airway therapy at bedtime, if prescribed for OSA. In cases involving infection, the nurse informs the patient that the symptoms of laryngitis often extend a week to 10 days after completion of antibiotic therapy. The nurse instructs the patient about signs and symptoms that require contacting the primary provider. These signs and symptoms include loss of voice with sore throat that makes swallowing saliva difficult, hemoptysis, and noisy respirations. Continued hoarseness after voice rest or laryngitis that persists for longer than 5 days must be reported because of the possibility of malignancy.

NURSING PROCESS

The Patient with Upper Airway Infection

Assessment

A health history may reveal signs and symptoms of headache, sore throat, pain around the eyes and on either side of the nose, difficulty in swallowing, cough, hoarseness, fever, stuffiness, and generalized discomfort and fatigue. Determining when the symptoms began, what precipitated them, what if anything relieves them, and what aggravates them is part of the assessment. The nurse should also determine any history of allergy or the existence of a concomitant illness. Inspection may reveal swelling, lesions, or asymmetry of the nose as well as bleeding or discharge. The nurse inspects the nasal mucosa for abnormal findings such as increased redness, swelling, exudate, and nasal polyps, which may develop in chronic rhinitis. The mucosa of the nasal turbinates may also be swollen (boggy) and pale bluish-gray. The nurse palpates the frontal and maxillary sinuses for tenderness, which suggests inflammation and then inspects the throat by having the patient open the mouth wide and take a deep breath. Redness, asymmetry, or evidence of drainage, ulceration, or enlargement of the tonsils and pharynx is abnormal. Palpation of the neck lymph nodes for enlargement and tenderness is necessary.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Ineffective airway clearance related to excessive mucus production secondary to retained secretions and inflammation
- Acute pain related to upper airway irritation secondary to an infection
- Impaired verbal communication related to physiologic changes and upper airway irritation secondary to infection or swelling
- Deficient fluid volume related to decreased fluid intake and increased fluid loss secondary to diaphoresis associated with a fever
- Deficient knowledge regarding prevention of URIs, treatment regimen, surgical procedure, or postoperative self-care

Collaborative Problems/Potential Complications

Based on the assessment data, potential complications include:

- Sepsis
- Meningitis or brain abscess
- Peritonsillar abscess, otitis media, or rhinosinusitis

Planning and Goals

The major goals for the patient may include maintenance of a patent airway, relief of pain, maintenance of effective means

of communication, normal hydration, knowledge of how to prevent upper airway infections, and absence of complications.

Nursing Interventions

Maintaining a Patent Airway

An accumulation of secretions can block the airway in patients with an upper airway infection. As a result, changes in the respiratory pattern occur and the work of breathing increases to compensate for the blockage. The nurse can implement several measures to loosen thick secretions or to keep the secretions moist so that they can be easily expectorated. Increasing fluid intake helps thin the mucus. The use of room vaporizers or steam inhalation also loosens secretions and reduces inflammation of the mucous membranes. To enhance drainage from the sinuses, the nurse instructs the patient about positioning; this depends on the location of the infection or inflammation. For example, drainage for rhinosinusitis or rhinitis is achieved in the upright position. In some conditions, topical or systemic medications, when prescribed, help relieve nasal or throat congestion.

Promoting Comfort

URIs usually produce localized discomfort. In rhinosinusitis, pain may occur in the area of the sinuses, or a general headache may be produced. In pharyngitis, laryngitis, or tonsillitis, a sore throat occurs. The nurse encourages the patient to take analgesics, such as acetaminophen with codeine, as prescribed, to relieve this discomfort. A pain intensity rating scale (see Chapter 9) may be used to assess effectiveness of pain relief measures. Other helpful measures include topical anesthetic agents for symptomatic relief of herpes simplex blisters (see Chart 40-3) and sore throats, hot packs to relieve the congestion of rhinosinusitis and promote drainage, and warm water gargles or irrigations to relieve the pain of a sore throat. The nurse encourages rest to relieve the generalized discomfort and fever that accompany many upper airway conditions (especially rhinitis, pharyngitis, and laryngitis). For postoperative care after tonsillectomy and adenoidectomy, an ice collar may reduce swelling and decrease bleeding.

Promoting Communication

Upper airway infections may result in hoarseness or loss of speech. The nurse instructs the patient to refrain from speaking as much as possible and, if possible, to communicate in writing instead. Additional strain on the vocal cords may delay full return of the voice. The nurse encourages the patient and family to use alternative forms of communication, such as a memo pad or a bell to signal for assistance.

Encouraging Fluid Intake

Upper airway infections lead to fluid loss. Sore throat, malaise, and fever may interfere with a patient's willingness to eat and drink. The nurse provides a list of easily ingested foods to increase caloric intake during the acute phase of illness. These include soups, gelatin, pudding, yogurt, cottage cheese, high-protein drinks, water, ice, and ice pops. The nurse encourages the patient to drink 2 to 3 L of fluid per day during the acute stage of airway infection, unless contraindicated, to thin the secretions and promote drainage. Liquids (hot or cold) may be soothing, depending on the disorder.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. Prevention of most upper airway infections is challenging because of the many potential causes. But because most URIs are transmitted by hand-to-hand contact, the nurse educates the patient and family about techniques to minimize the spread of infection to others, including implementing hand hygiene measures. The nurse advises the patient to avoid exposure to people who are at the risk for serious illness if respiratory infection is transmitted (older adults, immunosuppressed people, and those with chronic health problems).

The nurse instructs patients and their families about strategies to relieve symptoms of URIs and reinforces the need to complete the treatment regimen, particularly when antibiotics are prescribed.

Continuing and Transitional Care. Referral for home, community-based, or transitional care is rare. However, it may be indicated for people whose health status was compromised before the onset of the respiratory infection and for those who cannot manage self-care without assistance. In such circumstances, the home care nurse assesses the patient's respiratory status and progress in recovery. The nurse may advise older adult patients and those at increased risk from a respiratory infection to consider annual influenza and pneumococcal vaccination. A follow-up appointment with the primary provider may be indicated for patients with compromised health status to ensure that the respiratory infection has resolved.

Monitoring and Managing Potential Complications

Although major complications of URIs are rare, the nurse must be aware of them and assess the patient for them. Because most patients with URIs are managed at home, patients and their families must be instructed to monitor for signs and symptoms and to seek immediate medical care if the patient's condition does not improve or if the patient's physical status appears to be worsening.

Sepsis or meningitis may occur in patients with compromised immune status or in those with an acute bacterial infection. The patient and caregiver are instructed to seek medical care if the patient's condition fails to improve within several days after the onset of symptoms, if unusual symptoms develop, or if the patient's condition deteriorates. They are instructed about signs and symptoms that require further attention: persistent or high fever, increasing shortness of breath, confusion, and increasing weakness and malaise. The patient with sepsis requires expert care to treat the infection, stabilize vital signs, and prevent or treat septic shock (see Chapter 8). Deterioration of the patient's condition necessitates intensive care measures (e.g., hemodynamic monitoring and administration of vasoactive medications, IV fluids, nutritional support, and corticosteroids) to monitor the patient's status and to support the patient's vital signs. High doses of antibiotics may be given to treat the causative organism. The nurse's role is to monitor the patient's vital signs, hemodynamic status, and laboratory values; administer needed treatment; alleviate the patient's physical discomfort; and provide explanations, education, and emotional support to the patient and family.

Peritonsillar abscess may develop after an acute infection of the tonsils. The patient requires treatment to drain the abscess and receives antibiotics for infection and topical anesthetic agents and throat irrigations to relieve pain and sore throat. Follow-up is necessary to ensure that the abscess resolves; tonsillectomy may be required. The nurse assists the patient in administering throat irrigations and instructs the patient and family about the importance of adhering to the prescribed treatment regimen and recommended follow-up appointments.

In some severe situations, peritonsillar abscess may progress to meningitis or brain abscess. The nurse assesses for changes in

mental status ranging from subtle personality changes through drowsiness to coma, nuchal rigidity, and focal neurologic signs that signal increasing cerebral edema around the abscess (see Chapter 52). Seizures, typically tonic–clonic, occur in this setting. Intensive care measures are necessary. High doses of antibiotics may be used to treat the causative organism. The nurse's role is similar to caring for the patient with sepsis in an intensive care setting. The nurse monitors the patient's neurologic status and reports changes immediately.

Otitis media and rhinosinusitis may develop with URI. The patient and family are instructed about the signs and symptoms of otitis media and rhinosinusitis and about the importance of follow-up with the primary provider to ensure adequate evaluation and treatment of these conditions.

Evaluation

Expected patient outcomes may include the following:

1. Maintains a patent airway by managing secretions
   a. Reports decreased congestion
   b. Assumes best position to facilitate drainage of secretions
   c. Uses self-care measures appropriately and consistently to manage secretions during the acute phase of illness
2. Reports relief of pain and discomfort using pain intensity scale
   a. Uses comfort measures: analgesics, hot packs, gargles, rest
   b. Demonstrates adequate oral hygiene
3. Demonstrates ability to communicate needs, wants, level of comfort
4. Maintains adequate fluid and nutrition intake
5. Utilizes strategies to prevent upper airway infections and allergic reactions
   a. Demonstrates hand hygiene technique
   b. Identifies the value of the influenza vaccine
6. Demonstrates an adequate level of knowledge and performs self-care adequately
7. Becomes free of signs and symptoms of infection
   a. Exhibits normal vital signs (temperature, pulse, respiratory rate)
   b. Absence of purulent drainage
   c. Free of pain in ears, sinuses, and throat
   d. Absence of signs of inflammation
8. Absence of complications
   a. No signs of sepsis: fever, hypotension, deterioration of cognitive status
   b. Vital signs and hemodynamic status normal
   c. No evidence of neurologic involvement
   d. No signs of development of peritonsillar abscess
   e. Resolution of URI without development of otitis media or rhinosinusitis
   f. No signs and symptoms of brain abscess

OBSTRUCTION AND TRAUMA OF THE UPPER RESPIRATORY AIRWAY

Obstructive Sleep Apnea

OSA is a disorder characterized by recurrent episodes of upper airway obstruction and a reduction in ventilation. It is defined as cessation of breathing (apnea) during sleep usually caused by repetitive upper airway obstruction. The estimated prevalence of OSA is approximately 26% of adults between the ages of 30 and 70 years (Peppard, Young, Barnet, et al., 2013). Based on cross-sectional studies, the prevalence of OSA in India is reported to be 13.7%. Higher prevalence of OSA is associated with diabetes and obesity (Viswanathan, Ramalingam, & Nagaraj, 2017). OSA interferes with people's ability to obtain adequate rest, thus affecting memory, learning, and decision making.

Risk factors for OSA include obesity, male gender, postmenopausal status, and advanced age. The major risk factor is obesity; a larger neck circumference and increased amounts of peripharyngeal fat narrow and compress the upper airway. Other associated factors include alterations in the upper airway, such as structural changes (e.g., tonsillar hypertrophy, abnormal posterior positioning of one or both jaws, and variations in craniofacial structures) that contribute to the collapsibility of the upper airway (Downey, 2015).

Pathophysiology

The pharynx is a collapsible tube that can be compressed by the soft tissues and structures surrounding it. The tone of the muscles of the upper airway is reduced during sleep. Mechanical factors such as reduced diameter of the upper airway or dynamic changes in the upper airway during sleep may result in obstruction. These sleep-related changes may predispose to upper airway collapse when small amounts of negative pressure are generated during inspiration.

Repetitive apneic events result in hypoxia (decreased oxygen saturation) and hypercapnia (increased concentration of carbon dioxide), which triggers a sympathetic response. As a consequence, patients with OSA have a high prevalence of hypertension. In addition, OSA is associated with an increased risk of myocardial infarction and stroke (cerebrovascular accident), which may be mitigated with appropriate treatment (Downey, 2015).

Clinical Manifestations

OSA is characterized by frequent and loud snoring with breathing cessation for 10 seconds or longer, for at least five episodes per hour, followed by awakening abruptly with a loud snort as the blood oxygen level drops. Patients with sleep apnea may have anywhere from five apneic episodes per hour to several hundred per night.

Classic signs and symptoms of OSA include the "3S's"—namely, *s*noring, sleepiness, and significant-other report of sleep apnea episodes. Common signs and symptoms of OSA are presented in Chart 40-4. Symptoms typically progress with increases in weight and aging (Downey, 2015). Patients are typically unaware of nocturnal upper airway obstruction during sleep. They frequently complain of insomnia, including difficulty in going to sleep, nighttime awakenings, and early morning awakenings with an inability to go back to sleep, as well as chronic fatigue and hypersomnolence (daytime sleepiness). When obtaining the health history, the nurse asks the patient about sleeping during normal activities such as eating or talking. Patients with this symptom are considered to have pathologic hypersomnolence (Downey, 2015).

Assessment and Diagnostic Findings

The diagnosis of sleep apnea is based on clinical features plus a polysomnographic finding (i.e., sleep study), which is the definitive test for OSA. The test is an overnight study, performed

Chart 40-4 ASSESSMENT

Assessing for Obstructive Sleep Apnea

Be alert for the following signs and symptoms of obstructive sleep apnea:

- Excessive daytime sleepiness
- Frequent nocturnal awakening
- Insomnia
- Loud snoring
- Morning headaches
- Intellectual deterioration
- Personality changes, irritability
- Impotence
- Systemic hypertension
- Dysrhythmias
- Pulmonary hypertension, cor pulmonale
- Polycythemia
- Enuresis

Adapted from Downey, R. (2015). Obstructive sleep apnea. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/295807-overview

in a specialized sleep disorders center, which continuously measures multiple physiologic signals while the patient sleeps. These signals are analyzed as they are related to stages of sleep; measures include those taken by electroencephalogram (EEG), electro-oculogram, and chin electromyogram (EMG). In addition, cardiac rhythms and dysrhythmias are monitored with a single-lead electrocardiogram (ECG) and leg movements are recorded by an anterior tibialis EMG. Airflow at the nose and mouth is monitored using both a thermal sensor and a nasal pressure transducer, breathing effort is monitored using inductance plethysmography, and hemoglobin oxygen saturation is monitored by oximetry. The breathing pattern is analyzed for the presence of apneas and hypopneas. Characteristic findings consistent with OSA include apneic episodes occurring in the presence of respiratory muscle effort, clinically significant apneic episodes lasting 10 seconds or longer, and apneic episodes most prevalent during the rapid eye movement (REM) stage of sleep. Sleep disruption from automated patient arousal is usually seen at the termination of an episode of apnea (Downey, 2105).

Medical Management

Patients usually seek medical treatment because their sleeping partners express concern or because they experience excessive sleepiness at inappropriate times or settings (e.g., while driving a car). A variety of treatments are used. Weight loss, avoidance of alcohol, positional therapy (using devices that prevent patients from sleeping on their backs), and oral appliances such as mandibular advancement devices (MADs) are the first steps (American Sleep Apnea Association, 2015); (Downey, 2015). When applied correctly, an MAD advances the mandible so that it is slightly anterior to the upper front teeth, preventing airway obstruction by the tongue and soft tissue during sleep. A randomized controlled trial that compared the effectiveness of these devices among patients with OSA with the more conventional therapy, continuous positive airway pressure (CPAP), found no difference in short-term outcomes between MAD and CPAP, including daytime sleepiness and quality of life, suggesting that MAD is as effective a treatment as CPAP in patients with mild-to-moderate OSA (White & Shafazan, 2013). In more severe cases involving hypoxemia and severe hypercapnia, the treatment includes CPAP or bilevel positive airway pressure (BiPAP) therapy with supplemental oxygen via nasal cannula. CPAP is used to prevent airway collapse, whereas BiPAP makes breathing easier and results in a lower average airway pressure. (The use of CPAP and BiPAP is discussed in more detail in Chapter 11.)

Surgical Management

Surgical procedures also may be performed to correct OSA. Simple tonsillectomy may be effective for patients with larger tonsils when deemed clinically necessary, or when other options have failed or are refused by patients (Morgan, 2015). Uvulopalatopharyngoplasty is the resection of pharyngeal soft tissue and removal of approximately 15 mm of the free edge of the soft palate and uvula. Effective in about 50% of patients, it is more effective in eliminating snoring than apnea. Nasal septoplasty may be performed for gross anatomic nasal septal deformities. Maxillomandibular surgery may be performed to advance the maxilla and mandible forward in order to enlarge the posterior pharyngeal region (Morgan, 2015). Tracheostomy relieves upper airway obstruction but has numerous adverse effects, including speech difficulties and increased risk of infections. These procedures, as well as other maxillofacial surgeries, are reserved for patients with concomitant cardiovascular disease and life-threatening dysrhythmias or severe disability who have not responded to conventional therapy (Tierney et al., 2015).

Pharmacologic Therapy

Some medications are useful in managing symptoms associated with OSA. Modafinil (Provigil) has been used to reduce daytime sleepiness (Downey, 2015). Protriptyline (Triptil) given at bedtime may increase the respiratory drive and improve upper airway muscle tone. Medroxyprogesterone acetate (Provera) and acetazolamide (Diamox) have been used for sleep apnea associated with chronic alveolar hypoventilation; however, their benefits have not been well established. The patient must understand that these medications are not a substitute for CPAP, BiPAP, or MAD. Administration of low-flow nasal oxygen at night can help relieve hypoxemia in some patients but has little effect on the frequency or severity of apnea.

Nursing Management

The patient with OSA may not recognize the potential consequences of the disorder. Therefore, the nurse explains the disorder in terms that are understandable to the patient and relates symptoms (daytime sleepiness) to the underlying disorder. The nurse also instructs the patient and family about treatments, including the correct and safe use of CPAP, BiPAP, MAD, and oxygen therapy, if prescribed. The nurse educates the patient about the risk of untreated OSA and the benefits of treatment approaches.

Epistaxis (Nosebleed)

Epistaxis, a hemorrhage from the nose, is caused by the rupture of tiny, distended vessels in the mucous membrane of any area of the nose. Rarely does epistaxis originate in the densely vascular tissue over the turbinates. Most commonly, the site is the anterior septum, where three major blood vessels enter the nasal cavity: (1) the anterior ethmoidal artery on the forward part of the roof (Kiesselbach plexus), (2) the sphenopalatine artery in the posterosuperior region, and (3) the internal

Chart 40-5 RISK FACTORS

Epistaxis

- Local infections (vestibulitis, rhinitis, rhinosinusitis)
- Systemic infections (scarlet fever, malaria)
- Drying of nasal mucous membranes
- Nasal inhalation of corticosteroids (e.g., beclomethasone) or illicit drugs (e.g., cocaine)
- Trauma (digital trauma, blunt trauma, fracture, forceful nose blowing)
- Arteriosclerosis
- Hypertension
- Tumor (sinus or nasopharynx)
- Thrombocytopenia
- Use of aspirin
- Liver disease
- Osler–Weber–Rendu syndrome (hereditary hemorrhagic telangiectasia)

Adapted from Nguyen, Q. A. (2015). Epistaxis. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/863220-overview

maxillary branches (the plexus of veins located at the back of the lateral wall under the inferior turbinate).

Several risk factors are associated with epistaxis (see Chart 40-5).

Medical Management

Management of epistaxis depends on its cause and the location of the bleeding site. A nasal speculum, penlight, or headlight may be used to identify the site of bleeding in the nasal cavity. Most nosebleeds originate from the anterior portion of the nose. Initial treatment may include applying direct pressure. The patient sits upright with the head tilted forward to prevent swallowing and aspiration of blood and is directed to pinch the soft outer portion of the nose against the midline septum for 5 or 10 minutes continuously. Application of nasal decongestants (phenylephrine, one or two sprays) to act as vasoconstrictors may be necessary. If these measures are unsuccessful in stopping the bleeding, the nose must be examined using good illumination and suction to determine the site of bleeding. Visible bleeding sites may be cauterized with silver nitrate or electrocautery (high-frequency electrical current). A supplemental patch of Surgicel or Gelfoam may be used (Tierney et al., 2015).

Alternatively, a cotton tampon may be used to try to stop the bleeding. Suction may be used to remove excess blood and clots from the field of inspection. The search for the bleeding site should shift from the anteroinferior quadrant to the anterosuperior, then to the posterosuperior, and finally to the posteroinferior area. The field is kept clear by using suction and by shifting the cotton tampon.

If the origin of the bleeding cannot be identified, the nose may be packed with gauze impregnated with petrolatum jelly or antibiotic ointment; a topical anesthetic spray and decongestant agent may be used before the gauze packing is inserted, or a balloon-inflated catheter may be used (see Fig. 40-3). Alternatively, a compressed nasal sponge may be used. Once the sponge becomes saturated with blood or is moistened with a small amount of saline, it will expand and produce tamponade to halt the bleeding. The packing may remain in place for 3 to 4 days if necessary to control bleeding (Nguyen, 2015). Antibiotics may be prescribed because of the risk of iatrogenic rhinosinusitis and sepsis.

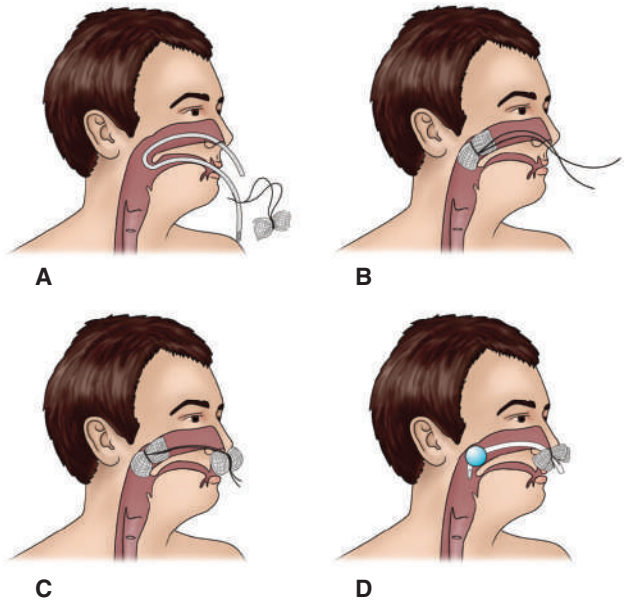


Figure 40-3 • Packing to control bleeding from the posterior nose. **A.** Catheter is inserted and packing is attached. **B.** Packing is drawn into position as the catheter is removed. **C.** Strip is tied over a bolster to hold the packing in place with an anterior pack installed "accordion pleat" style. **D.** Alternative method, using a balloon catheter instead of gauze packing.

Nursing Management

The nurse monitors the patient's vital signs, assists in the control of bleeding, and provides tissues and an emesis basin to allow the patient to expectorate any excess blood. It is common for patients to be anxious in response to a nosebleed. Blood loss on clothing and handkerchiefs can be frightening, and the nasal examination and treatment are uncomfortable. Assuring the patient in a calm, efficient manner that bleeding can be controlled can help reduce anxiety. The nurse continuously assesses the patient's airway and breathing as well as vital signs. On rare occasions, a patient with significant hemorrhage requires IV infusions of crystalloid solutions (normal saline) as well as cardiac and pulse oximetry monitoring.

Educating Patients About Self-Care

Once the bleeding is controlled, the nurse instructs the patient to avoid vigorous exercise for several days and to avoid hot or spicy foods and tobacco, because this may cause vasodilation and increase the risk of rebleeding. Discharge education includes reviewing ways to prevent epistaxis: avoiding forceful nose blowing, straining, high altitudes, and nasal trauma (including nose picking). Adequate humidification may prevent drying of the nasal passages. The nurse explains how to apply direct pressure to the nose with the thumb and the index finger for 15 minutes in the case of a recurrent nosebleed. If recurrent bleeding cannot be stopped, the patient is instructed to seek additional medical attention.

Nasal Obstruction

The passage of air through the nostrils is frequently obstructed by a deviation of the nasal septum, hypertrophy of the turbinate bones, or the pressure of nasal polyps. Chronic nasal congestion forces the patient to breathe through the mouth, thus producing

dryness of the oral mucosa and associated problems including persistent dry, cracked lips. Patients with chronic nasal congestion often suffer from sleep deprivation due to difficulty maintaining an adequate airway while lying flat and during sleep.

Persistent nasal obstruction also may lead to chronic infection of the nose and result in frequent episodes of nasopharyngitis. Frequently, the infection extends to the nasal sinuses. When rhinosinusitis develops and the drainage from these cavities is obstructed by deformity or swelling within the nose, pain is experienced in the region of the affected sinus.

Medical Management

The treatment of nasal obstruction requires the removal of the obstruction, followed by measures to treat whatever chronic infection exists. In many patients, an underlying allergy also requires treatment. Measures to reduce or alleviate nasal obstruction include nonsurgical as well as surgical techniques. Commonly used medications include nasal corticosteroids (see Table 40-2) as well as oral leukotriene inhibitors, such as montelukast. Treatment with nasal corticosteroids for 1 to 3 months is usually successful for the treatment of small polyps and may even reduce the need for surgical intervention. A short course of oral corticosteroids (6-day course of prednisone) may be beneficial in the treatment of nasal obstruction due to polyps (Tierney et al., 2015). Additional medications may include antibiotics for the treatment of underlying infection or antihistamines for the management of allergies. Hypertrophied turbinates may be treated by applying an astringent agent to shrink them.

A more aggressive approach in treating nasal obstruction caused by turbinate hypertrophy involves surgical reduction in the hypertrophy. Surgical procedures used to treat obstructive nasal conditions are collectively known as functional rhinoplasty. Technical advances with newer techniques provide a number of options for reconstruction and reshaping of the nose.

Nursing Management

When a surgical procedure is indicated, most often it is performed on an outpatient basis. The nurse explains the procedure to the patient. Postoperatively, the nurse elevates the head of the bed to promote drainage and to alleviate discomfort from edema. Frequent oral hygiene is encouraged to overcome dryness caused by breathing through the mouth. Before discharge from the outpatient or same-day surgical unit, the patient is instructed to avoid blowing the nose with force during the postoperative recovery period. The patient is also instructed about the signs and symptoms of bleeding and infection and when to contact the primary provider. The patient is provided with written postoperative instructions, including emergency phone numbers.

Fractures of the Nose

The location of the nose makes it susceptible to injury. Nasal fracture is the most common facial fracture and the most common fracture in the body (Becker, 2014). Fractures of the nose usually result from a direct assault. Nasal fractures may affect the ascending process of the maxilla and the septum. The torn mucous membrane results in a nosebleed. Complications include hematoma, infection, abscess, and avascular or septic necrosis. However, as a rule, serious consequences usually do not occur.

Clinical Manifestations

The signs and symptoms of a nasal fracture are pain, bleeding from the nose externally and internally into the pharynx, swelling of the soft tissues adjacent to the nose, periorbital ecchymosis, nasal obstruction, and deformity. The patient's nose may have an asymmetric appearance that may not be obvious until the edema subsides.

Assessment and Diagnostic Findings

The nose is examined internally to rule out the possibility that the injury may be complicated by a fracture of the nasal septum and a submucosal septal hematoma. Intranasal examination is performed in all cases to rule out septal hematoma (Tierney et al., 2015). Because of the swelling and bleeding that occur with a nasal fracture, an accurate diagnosis can be made only after the swelling subsides.

Clear fluid draining from either nostril suggests a fracture of the cribriform plate with leakage of cerebrospinal fluid. Usually, careful inspection or palpation discloses any deviations of the bone or disruptions of the nasal cartilages. An x-ray may reveal displacement of the fractured bones and may help rule out extension of the fracture into the skull.

Medical Management

A nasal fracture very often produces bleeding from the nasal passage. As a rule, bleeding is controlled with the use of packing. Cold compresses are used to prevent or reduce edema. For the patient who has sustained enough trauma to break the nose or any facial bone, the emergency medical team must consider the possibility of a cervical spine fracture. Therefore, it is essential to ensure a patent airway and to rule out a cervical spine fracture (see Chapter 51). Uncomplicated nasal fractures may be treated initially with antibiotics, analgesic agents, and a decongestant nasal spray.

Treatment of nasal fractures is aimed at restoring nasal function and returning the appearance of the nose to baseline. The patient is referred to a specialist to evaluate the need to realign the bones. Although improved outcomes are obtained when reduction in the fracture is performed during the first 3 hours after the injury, this is often not possible because of the edema. If immediate reduction in the fracture is not possible, it is performed within 3 to 7 days. Timing is important when treating nasal fractures because further delay in treatment may result in significant bone healing, which ultimately may require surgical intervention that includes rhinoplasty to reshape the external appearance of the nose. A septorhinoplasty is performed when the nasal septum needs to be repaired. In patients who develop a septal hematoma, the physician drains the hematoma through a small incision. A septal hematoma that is not drained can lead to permanent deformity of the nose.

Nursing Management

Immediately after the fracture, the nurse applies ice and encourages the patient to keep the head elevated. The nurse instructs the patient to apply ice packs to the nose to decrease swelling. The patient who experiences bleeding from the nose (epistaxis) is usually frightened and anxious and needs reassurance. The packing inserted to stop the bleeding may be uncomfortable and unpleasant, and obstruction of the nasal passages by the packing forces the patient to breathe through the mouth. This in turn causes the oral mucous membranes to become dry. Mouth rinses

help to moisten the mucous membranes and to reduce the odor and taste of dried blood in the oropharynx and nasopharynx. The use of analgesic agents such as acetaminophen/paracetamol or NSAIDs (i.e., ibuprofen or naproxen) is encouraged. When removing the cotton pledgets, the nurse carefully inspects the mucosa for lacerations or a septal hematoma. The nurse instructs the patient to avoid sports activities for 6 weeks.

Laryngeal Obstruction

Obstruction of the larynx because of edema is a serious condition that may be fatal without swift, decisive intervention. The larynx is a stiff box that will not stretch. It contains a narrow space between the vocal cords (glottis), through which air must pass. Swelling of the laryngeal mucous membranes may close off the opening tightly, leading to life-threatening hypoxia or suffocation. Edema of the glottis occurs rarely in patients with acute laryngitis, occasionally in patients with urticaria, and more frequently in patients with severe inflammation of the throat, as in scarlet fever. It is an occasional cause of death in severe anaphylaxis (angioedema).

Hereditary angioedema is also characterized by episodes of life-threatening laryngeal edema. Laryngeal edema in people with hereditary angioedema can occur at any age, although young adults are at greatest risk. Some causes of laryngeal obstruction appear in Table 40-3.

Foreign bodies frequently are aspirated into the pharynx, the larynx, or the trachea and cause a twofold problem. First, they obstruct the air passages and cause difficulty in breathing, which may lead to asphyxia; later, they may be drawn farther down, entering the bronchi or a bronchial branch and causing symptoms of irritation, such as a croupy cough, expectoration of blood or mucus, or labored breathing.

Clinical Manifestations

The patient's clinical presentation and x-ray findings confirm the diagnosis of laryngeal obstruction. The patient may demonstrate lowered oxygen saturation; however, normal oxygen saturation should not be interpreted as a sign that the obstruction is not significant. The use of accessory muscles to maximize airflow may occur and is often manifested by retractions in the neck or abdomen during inspirations. Patients who demonstrate these symptoms are at an immediate risk of collapse, and respiratory support (i.e., mechanical ventilation or positive-pressure ventilation) is considered.

TABLE 40-3 Causes of Laryngeal Obstruction

Precipitating Event	Mechanism of Obstruction
History of allergies; exposure to medications, latex, foods (peanuts, tree nuts [e.g., walnuts, pecans]), bee stings	Anaphylaxis
Foreign body	Inhalation/ingestion of meat or other food items, coin, chewing gum, balloon fragments, drug packets (ingested to avoid criminal arrest)
Heavy alcohol consumption; heavy tobacco use	Obstruction from tumor
Family history of airway problems	Suggests angioedema (type I hypersensitivity reaction)
Use of angiotensin-converting enzyme inhibitor	Increased risk of angioedema of the mucous membranes
Recent throat pain or recent fever	Infectious process
History of surgery or previous tracheostomy	Possible subglottic stenosis

Adapted from Reardon, R. F., Mason, P. E., & Clinton, J. E. (2014). Basic airway management and decision-making. In J. D. Roberts (Ed.). Roberts & Hedges' clinical procedures in emergency medicine (6th ed). Philadelphia, PA: Elsevier Saunders.

Assessment and Diagnostic Findings

A thorough history can be very useful in diagnosing and treating the patient with a laryngeal obstruction. However, emergency measures to secure the patient's airway should not be delayed to obtain a history or perform tests. If possible, the nurse obtains a history from the patient or family about heavy alcohol or tobacco consumption, current medications, history of airway problems, recent infections, pain or fever, dental pain or poor dentition, and any previous surgeries, radiation therapy, or trauma.

Medical Management

Medical management is based on the initial evaluation of the patient and the need to ensure a patent airway. If the airway is obstructed by a foreign body and signs of asphyxia are apparent, immediate treatment is necessary. Emergent maneuvers to clear an airway obstruction were presented in Chapter 60. If all efforts are unsuccessful, an immediate tracheotomy is necessary. If the obstruction is caused by edema resulting from an allergic reaction, treatment may include immediate administration of subcutaneous epinephrine and a corticosteroid (see Chapter 56). Ice may be applied to the neck in an effort to reduce edema. Continuous pulse oximetry is essential in the patient who has experienced acute upper airway obstruction.

Cancer of the Larynx

Cancer of the larynx accounts for approximately half of all head and neck cancers. Laryngeal cancer is the ninth common cancer in India and it is the seventh common cancer in Asia. Laryngeal cancer constitutes 3–6% of all cancers occurring among men. Males in the age group of 60–69 years are more affected than females and those in the younger age group. The age-adjusted rate of laryngeal cancer was 33,642 in 2015 and is expected to increase to 39,636 by 2020 (National Centre For Disease Informatics, 2017). There is huge regional variation in the age-adjusted rate of laryngeal cancer incidence with highest being reported from Kamrup urban registry—8.18 per 100,000 population—and lowest reported incidence is 1.26 from Nagaland (Bobdey, Jain, & Balasubramanium, 2015). Most common risk factor of laryngeal cancer is tobacco. Many other risk factors identified are presented in Chart 40-6.

Almost all malignant tumors of the larynx arise from the surface epithelium and are classified as squamous cell carcinoma. Approximately 55% of patients with laryngeal cancer present with involved lymph nodes at the time of diagnosis, with bilateral lesions present in 16% of patients (De Vita, Hellman, & Rosenberg, 2014). Recurrence occurs usually within the first 2 to 3 years after diagnosis. The presence of disease after 5 years is often secondary to a new primary malignancy. The incidence of distant metastasis with squamous cell carcinoma of the head and neck (including larynx cancer) is relatively low.

Chart 40-6 RISK FACTORS

Laryngeal Cancer

Carcinogens

- Tobacco (smoke, smokeless, e-cigarettes, hookahs)
- Combined effects of alcohol and tobacco
- Asbestos
- Secondhand smoke
- Paint fumes
- Wood dust
- Cement dust
- Chemicals
- Tar products
- Mustard gas
- Leather and metals

Other Factors

- Nutritional deficiencies (vitamins)
- History of alcohol abuse
- Genetic predisposition
- Age (higher incidence after 65 years of age)
- Gender (more common in men)
- Race (more prevalent in African Americans and Caucasians)
- Weakened immune system

Adapted from American Cancer Society. (2015). *What are the risk factors for laryngeal and hypopharyngeal cancers*? Retrieved on 3/9/2016 at: www.cancer.org/Cancer/LaryngealandHypopharyngealCancer/DetailedGuide/laryngeal-and-hypopharyngeal-cancer-risk-factors

Clinical Manifestations

Hoarseness of more than 2 weeks' duration occurs in the patient with cancer in the glottic area because the tumor impedes the action of the vocal cords during speech. The voice may sound harsh, raspy, and lower in pitch. Affected voice sounds are not always early signs of subglottic or supraglottic cancer, however. The patient may complain of a persistent cough or sore throat and pain and burning in the throat, especially when consuming hot liquids or citrus juices. A lump may be felt in the neck. Later symptoms include dysphagia, dyspnea (difficulty breathing), unilateral nasal obstruction or discharge, persistent hoarseness, persistent ulceration, and foul breath. Cervical lymph adenopathy, unintentional weight loss, a general debilitated state, and pain radiating to the ear may occur with metastasis.

Assessment and Diagnostic Findings

An initial assessment includes a complete history and physical examination of the head and neck. This includes identification of risk factors, family history, and any underlying medical conditions. An indirect laryngoscopy, using a flexible endoscope, is initially performed in the otolaryngologist's office to visually evaluate the pharynx, larynx, and possible tumor. Mobility of the vocal cords is assessed; if normal movement is limited, the growth may affect muscle, other tissue, and even the airway. The lymph nodes of the neck and the thyroid gland are palpated for enlargement.

Diagnostic procedures that may be used include fine-needle aspiration (FNA) biopsy, a barium swallow, endoscopy, CT or MRI scan, and a positron emission tomography (PET) scan (ACS, 2015). FNA biopsy may be done as an initial screening procedure to obtain samples of any enlarged lymph nodes in the neck. A barium swallow may be done if the patient initially presents with a chief complaint of difficulty in swallowing, to outline any structural anomalies of the neck that could pinpoint a tumor. However, if a tumor of the larynx is suspected on an initial examination, a direct laryngoscopic examination is indicated. Laryngoscopy is performed under local or general anesthesia to evaluate all areas of the larynx. In some cases, intraoperative examination obtained by direct microscopic visualization and palpation of the vocal folds may yield a more accurate diagnosis. Samples of the suspicious tissue are obtained for analysis. It is rare for human papillomavirus (HPV) to be implicated with laryngeal cancers, although it is frequently implicated in oral cancers. Whether or not the tumor is positive for HPV does not have an effect on the course of treatment (ACS, 2015).

The classification, including stage of the tumor (i.e., size and histology of the tumor, presence and extent of cervical lymph node involvement) and location of the tumor serve as a basis for treatment. CT scanning and MRI are used to assess regional adenopathy and soft tissues and to stage and determine the extent of a tumor. MRI is also helpful in posttreatment follow-up to detect a recurrence. PET scanning may also be used to detect recurrence of the laryngeal tumor after treatment.

Medical Management

The goals of treatment of laryngeal cancer include cure; preservation of safe, effective swallowing; preservation of useful voice; and avoidance of permanent tracheostoma (Tierney et al., 2015). Treatment options include surgery, radiation therapy, and adjuvant chemoradiation therapy. The prognosis depends on the tumor location (i.e., supraglottic, glottis, and subglottic), as well as the tumor grade and stage (i.e., using the TNM system; see Chapter 58). The treatment plan also depends on whether the cancer is an initial diagnosis or a recurrence. In addition, before treatment begins, a complete dental examination is performed to rule out any oral disease. A consultation with a dental oncologist may be warranted. Any dental problems are resolved, if possible, before surgery and radiotherapy (ACS, 2015).

For patients with early-stage tumors (i.e., stages I and II) and lesions without lymph node involvement, external-beam radiation therapy or conservation surgery (i.e., less invasive surgery, such as vocal cord stripping or cordectomy) may be effective. Other indicated surgical procedures may include transoral endoscopic laser excision or partial laryngectomy (NCI, 2015). Patients with stage III and IV tumors that are resectable may be advised to have either total laryngectomies with or without postoperative radiation therapy or radiation therapy with concurrent adjuvant chemotherapy (with single-agent cisplatin) and surgical resection aimed at preserving some of the larynx (i.e., organ preservation surgery). Patients with late-stage tumors that extend through cartilage and into soft tissues are generally advised to have total laryngectomies with postoperative radiation therapy (NCI, 2015).

Patients should be educated so that they carefully consider the various side effects and complications associated with the different treatment modalities. The presence of lymph node involvement in the neck can affect the outcome. Supraglottic tumors metastasize early and bilaterally even when there appears to be no lymph node involvement at the time of diagnosis. When the neck lymph nodes are involved, the treatment includes surgery, chemoradiation, or both (Tierney et al., 2015).

Surgical Management

The overall goals for the patient undergoing surgical treatment include minimizing the effects of surgery on speech, swallowing, and breathing while maximizing the cure of the cancer. Several

different curative procedures are available that can offer voice-sparing results while achieving a positive cure rate for the patient who has an early laryngeal carcinoma. Surgical options include vocal cord stripping, cordectomy, laser surgery, partial laryngectomy, or total laryngectomy (NCI, 2015).

Vocal Cord Stripping

Stripping of the vocal cord is used to treat dysplasia, hyperkeratosis, and leukoplakia and is often curative for these lesions. The procedure involves removal of the mucosa of the edge of the vocal cord, using an operating microscope. Early vocal cord lesions are initially treated with radiation therapy.

Cordectomy

Cordectomy, which is an excision of the vocal cord, is usually performed via transoral laser. This procedure is used for lesions limited to the middle third of the vocal cord. The resulting voice quality is related to the extent of tissue removed.

Laser Surgery

Laser microsurgery is well known to have several advantages for the treatment of early glottic cancers. Treatment and recovery are shorter, with fewer side effects, and treatment may be less costly than for other forms of therapy. Microelectrodes are useful for surgical resection of smaller laryngeal carcinomas. The carbon dioxide (CO_2) laser can be used for the treatment of many laryngeal tumors, with the exception of large vascular tumors. When compared with the results of other treatments for early laryngeal cancer, laser microsurgery is considered to be the method of choice based on patient outcomes (NCI, 2015).

Partial Laryngectomy

A partial laryngectomy (laryngofissure–thyrotomy) is often used for patients in the early stages of cancer in the glottic area when only one vocal cord is involved. The surgery is associated with a very high cure rate. It may also be performed for recurrence when high-dose radiation has failed. A portion of the larynx is removed, along with one vocal cord and the tumor; all other structures remain. The airway remains intact, and the patient is expected to have no difficulty swallowing. The voice quality may change, or the patient may sound hoarse.

Total Laryngectomy

Complete removal of the larynx (total laryngectomy) can provide a cure in most advanced laryngeal cancers, when the tumor extends beyond the vocal cords, or for cancer that recurs or persists after radiation therapy. In a total laryngectomy, the laryngeal structures are removed, including the hyoid bone, epiglottis, cricoid cartilage, and two or three rings of the trachea. The tongue, pharyngeal walls, and most of the trachea are preserved. A total laryngectomy results in permanent loss of the voice and a change in the airway, requiring a permanent tracheostomy (see Fig. 40-4). Occasionally, patients continue to have a laryngectomy tube in the stoma. Laryngectomy tubes are similar in appearance to tracheostomy tubes; however, a laryngectomy tube can be distinguished from a tracheostomy tube because the patient is unable to speak or breathe when the laryngectomy tube is occluded. Patients who have a total laryngectomy require alternatives to normal speech; these may include a prosthetic device, such as a Blom-Singer valve, to speak without aspirating (see later discussion).

Surgery is more difficult when the lesion involves the midline structures or both vocal cords. With or without neck dissection, a total laryngectomy requires a permanent tracheal stoma because the larynx that provides the protective sphincter is no longer present. The tracheal stoma prevents the aspiration of food and fluid into the lower respiratory tract. The patient has no voice but has normal swallowing. A total laryngectomy changes the manner in which airflow is used for breathing and speaking, as depicted in Figure 40-4. The patient has significant loss of the natural voice and the need to breathe through an opening (stoma) created in the lower neck. Complications that may occur include a salivary leak, wound infection from the development of a pharyngocutaneous fistula, stomal stenosis, and dysphagia secondary to esophageal stricture. In some cases, the patient may be a candidate for a near-total laryngectomy. In this situation, the patient would be a candidate for chemoradiation therapy regimens postoperatively. Voice preservation can be achieved in most cases and tends to be associated with overall improved quality of life (Aalia, 2014). Advances in surgical techniques for treating laryngeal cancer

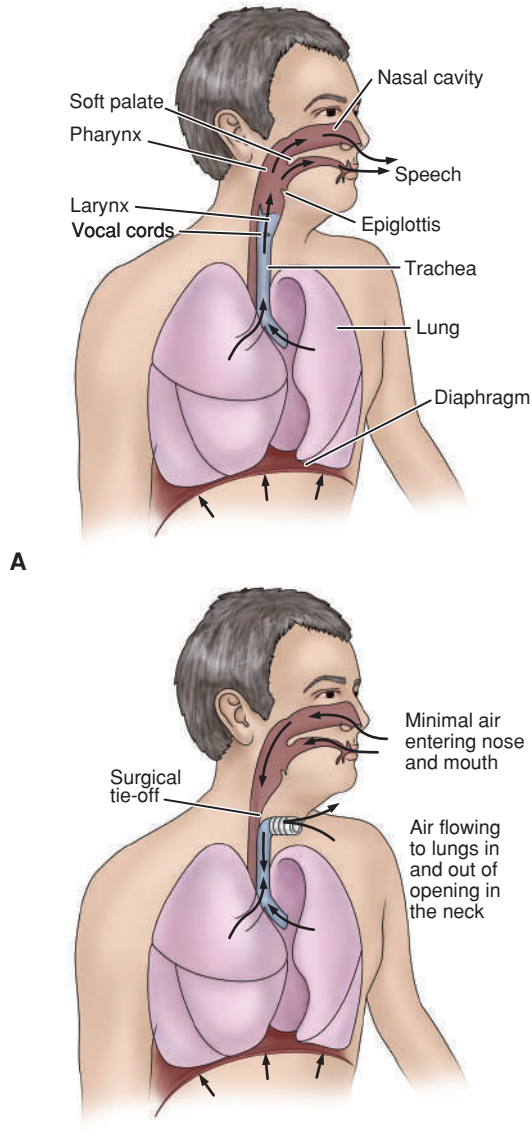


Figure 40-4 • Total laryngectomy produces a change in airflow for breathing and speaking. **A.** Normal airflow. **B.** Airflow after total laryngectomy.

may minimize the cosmetic and functional deficits previously seen with total laryngectomy. Some microlaryngeal surgery can be performed endoscopically.

Radiation Therapy

The goal of radiation therapy is to eradicate the cancer and preserve the function of the larynx. The decision to use radiation therapy is based on several factors, including the staging of the tumor and the patient's overall health status, lifestyle (including occupation), and personal preference. Excellent results have been achieved with radiation therapy in patients with early-stage glottic tumors when only one vocal cord is involved and there is normal mobility of the cord (i.e., with phonation), as well as in small supraglottic lesions. One of the benefits of radiation therapy is that patients retain a near-normal voice. A few may develop chondritis (inflammation of the cartilage) or stenosis; a small number may later require laryngectomy.

Radiation therapy may also be used preoperatively to reduce the tumor size. Radiation therapy is combined with surgery in advanced laryngeal cancer as adjunctive therapy to surgery or chemotherapy and as a palliative measure.

Complications from radiation therapy are a result of external radiation to the head and neck area, which may also include the parotid gland, which is responsible for mucus production. Symptoms may include acute mucositis, ulceration of the mucous membranes, pain, xerostomia (dry mouth), loss of taste, dysphasia, fatigue, and skin reactions. Later complications may include laryngeal necrosis, edema, and fibrosis (see Chapter 58).

Speech Therapy

The patient who undergoes a laryngectomy and the patient's family face potentially complex challenges, including significant changes in the ability to communicate. To minimize anxiety and frustration on the part of the patient and family, the loss or alteration of speech is discussed with them. To plan postoperative communication strategies and speech therapy, the speech therapist or pathologist conducts a preoperative evaluation (ACS, 2015). During this time, the nurse discusses with the patient and family the methods of communication that will be available in the immediate postoperative period. These include writing, lip speaking and reading, and communication or word boards. A system of communication is established with the patient, family, nurse, and primary provider and is implemented consistently after surgery.

In addition, a long-term postoperative communication plan for alaryngeal communication is developed. The three most common techniques of alaryngeal communication are esophageal speech, artificial larynx (electric larynx), and tracheoesophageal puncture. Training in these techniques begins once medical clearance is obtained from the primary provider.

Esophageal Speech

The patient needs the ability to compress air into the esophagus and expel it, setting off a vibration of the pharyngeal esophageal segment for esophageal speech. The technique can be taught once the patient begins oral feedings, approximately 1 week after surgery. First, the patient learns to belch and is reminded to do so an hour after eating. Then, the technique is practiced repeatedly. Later, this conscious belching action is transformed into simple explosions of air from the esophagus for speech purposes. The speech therapist continues to work with the patient to make speech intelligible and as close to normal as possible. Because it takes a long time to become proficient, the success rate is low (ACS, 2015).

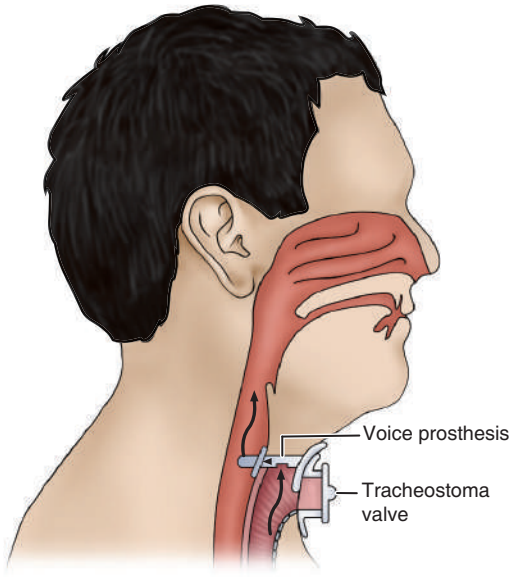


Figure 40-5 • Schematic representation of tracheoesophageal puncture speech. Air travels from the lung through a puncture in the posterior wall of the trachea into the esophagus and out the mouth. A voice prosthesis is fitted over the puncture site.

Artificial Larynx

If esophageal speech is not successful, or until the patient masters the technique, an electric larynx may be used for communication. This battery-powered apparatus projects sound into the oral cavity. When the mouth forms words (articulation), the sounds from the electric larynx become audible words. The voice that is produced sounds mechanical, and some words may be difficult to understand. The advantage is that the patient is able to communicate with relative ease while working to become proficient at either esophageal or tracheoesophageal puncture speech.

Tracheoesophageal Puncture

The third technique of alaryngeal speech is tracheoesophageal puncture (see Fig. 40-5). This technique for voice restoration is simple and has few complications. It is associated with high phonation success, good phonation quality, and steady long-term results. This technique is the most widely used because the speech associated with it most resembles normal speech (the sound produced is a combination of esophageal speech and voice), and it is easily achieved either during the initial surgery to treat the tumor or at a later date (ACS, 2015). A valve is placed in the tracheal stoma to divert air into the esophagus and out the mouth. Once the puncture is surgically created and has healed, a voice prosthesis (Blom-Singer) is fitted over the puncture site. A speech therapist teaches the patient how to produce sounds. Moving the tongue and lips to form the sound into words produces speech as before. To prevent airway obstruction, the prosthesis is removed and cleaned when mucus builds up.

NURSING PROCESS

The Patient Undergoing Laryngectomy

Assessment

The nurse obtains a health history and assesses the patient's physical, psychosocial, and spiritual domains. The health history

focuses on the following symptoms: hoarseness, sore throat, dyspnea, dysphagia, and pain or burning in the throat. The physical assessment includes a thorough head and neck examination with an emphasis on the patient's airway. In addition, the neck and thyroid are palpated for swelling, nodularity, or adenopathy.

The nurse also assesses the patient's general state of nutrition, including height and weight and body mass index and reviews laboratory values that assist in determining the patient's nutritional status (albumin, protein, glucose, and electrolyte levels). If treatment includes surgery, the nurse must know the nature of the surgery to plan appropriate care. If the patient is expected to have no voice as a result of the surgical procedure, a preoperative evaluation by the speech therapist is essential. The patient's ability to hear, see, read, and write is assessed. Visual impairment and functional illiteracy may create additional problems with communication and may require creative approaches to ensure that the patient is able to communicate any needs. Because alcohol abuse is a risk factor for cancer of the larynx, the patient's pattern of alcohol intake must be assessed. Patients who are accustomed to daily consumption of alcohol are at the risk for alcohol withdrawal syndrome (delirium tremens) when alcohol intake is stopped suddenly. It is also not uncommon that patients are active smokers at the time of diagnosis; assessment of readiness for smoking cessation should be done, and nicotine replacements prescribed to avoid nicotine withdrawal, as indicated (NCI, 2015) (see Chapter 21 Promoting Cessation of Tobacco Use).

In addition, the nurse assesses the psychological readiness of the patient and family. The fear of a diagnosis of cancer is compounded by the possibility of permanent voice loss and, in some cases, some degree of disfigurement. The nurse evaluates the patient's and family's knowledge of the planned surgical procedure and expected postoperative course and assesses their coping methods and support systems. The nurse assesses the patient's spirituality needs based on the patient's individual preferences, beliefs, and culture.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Deficient knowledge about the surgical procedure and postoperative course
- Anxiety related to the diagnosis of cancer and impending surgery
- Ineffective airway clearance related to excess mucus production secondary to surgical alterations in the airway
- Impaired verbal communication related to anatomic deficit secondary to removal of the larynx and to edema
- Imbalanced nutrition: less than body requirements, related to inability to ingest food secondary to swallowing difficulties
- Disturbed body image and low self-esteem secondary to major neck surgery, change in appearance, and altered structure and function
- Self-care deficit related to pain, weakness, fatigue, musculoskeletal impairment related to surgical procedure and postoperative course

Collaborative Problems/Potential Complications

Based on the assessment data, potential complications may include the following:

- Respiratory distress (hypoxia, airway obstruction, tracheal edema)
- Hemorrhage, infection, and wound breakdown
- Aspiration
- Tracheostomal stenosis

Planning and Goals

The major goals for the patient may include attainment of an adequate level of knowledge, reduction in anxiety, maintenance of a patent airway (patient is able to handle own secretions), effective use of alternative means of communication, attainment of optimal levels of nutrition and hydration, improvement in body image and self-esteem, improved self-care management, and absence of complications.

Nursing Interventions

Providing Preoperative Patient Education

The diagnosis of laryngeal cancer often produces misconceptions and fears. Many people assume that loss of speech and disfigurement are inevitable with this condition. Once the primary provider explains the diagnosis and discusses treatment options with the patient and family, the nurse clarifies any misconceptions by identifying the location of the larynx, its function, the nature of the planned surgical procedure, and its effect on speech. Further, the patient's ability to sing, laugh, and whistle will be lost. Informational materials (written and audiovisual) about the surgery are given to the patient and family for review and reinforcement. If a complete laryngectomy is planned, the patient must understand that the natural voice will be lost, but that special training can provide a means for communicating. The patient needs to know that until training is started, communication will be possible by using the call light, by writing, or by using a communication device. The interdisciplinary team conducts an initial assessment of the patient and family. In addition to the nurse in charge of the patient's care and the primary provider, the team might include an advanced practice nurse (e.g., nurse practitioner), speech therapist, respiratory therapist, social worker, dietitian, and home care nurse.

The nurse also reviews equipment and treatments for postoperative care with the patient and family, teaches important coughing and deep-breathing exercises, and helps the patient perform return demonstrations. The nurse clarifies the patient's role in the postoperative and rehabilitation periods. The family's needs must also be addressed because family members are often responsible for complex care of the patient in the home.

Reducing Anxiety

Because surgery of the larynx is performed most often for a malignant tumor, the patient may have many questions: Will the surgeon be able to remove all of the tumor? Is it cancer? Will I die? Will I choke? Will I suffocate? Will I ever speak again? What will I look like? Because of these and other questions, the psychological preparation of the patient is as important as the physical preparation.

Any patient undergoing surgery may have many fears. In laryngeal surgery, these fears may relate to the diagnosis of cancer and the possibility of permanent loss of the voice and disfigurement. The nurse provides the patient and family with opportunities to ask questions, verbalize feelings, and discuss perceptions. The nurse should address any questions and misconceptions the patient and family have. During the preoperative or postoperative period, a visit from someone who has had a laryngectomy may reassure the patient that people are available to assist and that rehabilitation is possible.

In the immediate postoperative period, the nurse attempts to build trust and reduce the patient's anxiety. Active listening provides an environment that promotes open communication and allows the patient to verbalize feelings. Clear instructions and explanations are given to the patient and family in a calm, reassuring manner. The nurse listens attentively, encourages the patient, and identifies and reduces environmental stressors. The nurse seeks to learn from the patient what activities promote feelings of comfort and assists the patient in such activities (e.g., listening to music, reading). Relaxation techniques such as guided imagery and meditation are often helpful. The nurse remains with the patient during episodes of severe anxiety and includes the patient in decision making.

Maintaining a Patent Airway

The nurse helps maintain a patent airway by positioning the patient in the semi-Fowler or Fowler position after recovery from anesthesia. This position decreases surgical edema and promotes lung expansion. Observing the patient for restlessness, labored breathing, apprehension, and increased pulse rate helps identify possible respiratory or circulatory problems. The nurse assesses the patient's lung sounds and reports changes that may indicate impending complications. Medications that depress respiration, particularly opioids, should be used cautiously. However, adequate use of analgesic medications is essential for pain relief because postoperative pain can result in shallow breathing and an ineffective cough (see Chapter 9 for discussion of pain management). The nurse encourages the patient to turn, cough, and take deep breaths. If necessary, suctioning may be performed to remove secretions, but disruption of suture lines must be avoided. The nurse also encourages and assists the patient with early ambulation to prevent atelectasis, pneumonia, and venous thromboemboli formation (e.g., pulmonary embolism and deep vein thrombosis). Pulse oximetry is used to monitor the patient's oxygen saturation level.

If a total laryngectomy was performed, a laryngectomy tube will most likely be in place. In some instances a laryngectomy tube is not used; in others it is used temporarily; and in many it is used permanently. The laryngectomy tube, which is shorter than a tracheostomy tube but has a larger diameter, is the patient's only airway. The care of this tube is similar to that for a tracheostomy tube (see Chapter 11). The nurse changes the inner cannula (if present) every 8 hours if it is disposable. Although nondisposable tubes are used infrequently, if one is used, the nurse cleans the inner cannula every 8 hours or more often as needed. If a tracheostomy tube without an inner cannula is used, humidification and suctioning of this tube are essential to prevent formation of mucus plugs. If a T-shaped laryngectomy tube is used, both sides of the T-tube should be suctioned to prevent obstruction due to copious secretions. The nurse should also use secure tracheostomy ties to prevent tube dislodgement. The nurse cleans the stoma daily with soap and water or another prescribed solution and a soft cloth or gauze, taking care to prevent water and soap or solution from entering the stoma. If a non–oil-based antibiotic ointment is prescribed, it is applied around the stoma and suture line. If crusting appears around the stoma, the crusts are removed with sterile tweezers and additional ointment is applied.

Wound drains, inserted during surgery, may be in place to assist in removal of fluid and air from the surgical site. Suction also may be used, but cautiously, to avoid trauma to the surgical site and incision. The nurse observes, measures, and records drainage. When drainage is less than 30 mL/day for 2 consecutive days, the surgeon usually removes the drains.

Frequently, the patient coughs up large amounts of mucus through this opening. Because air passes directly into the trachea without being warmed and moistened by the upper respiratory mucosa, the tracheobronchial tree compensates by secreting excessive amounts of mucus. Therefore, the patient has frequent coughing episodes and may develop a brassy-sounding, mucus-producing cough. The nurse reassures the patient that these problems will diminish in time as the tracheobronchial mucosa adapts to the altered physiology.

After the patient coughs, the tracheostomy opening must be wiped clean and clear of mucus. A simple gauze dressing, washcloth, or even paper towel (because of its size and absorbency) worn below the tracheostomy may serve as a barrier to protect the clothing from the copious mucus that the patient may initially expel.

One of the most important factors in decreasing cough, mucus production, and crusting around the stoma is adequate humidification of the environment. Mechanical humidifiers and aerosol generators (nebulizers) increase the humidity and are important for the patient's comfort. The laryngectomy tube may be removed when the stoma is well healed, within 3 to 6 weeks after surgery. The nurse teaches the patient how to clean and change the tube (see Chapter 11) and remove secretions.

Promoting Alternative Communication Methods

Establishing an effective means of communication is usually the ultimate goal in the rehabilitation of the laryngectomy patient. To understand and anticipate the patient's postoperative needs, the nurse works with the patient, speech therapist, and family to encourage the use of alternative communication methods. These means of communication are established preoperatively and must be used consistently by all personnel who come in contact with the patient postoperatively. The patient is now unable to use an intercom system. A call bell or hand bell must be placed within easy reach of the patient. In the immediate postoperative period, a handheld communication device like a Magic Slate can be used for communication; as alternatives, electronic tablets, notebooks, and smart phones can be used if the patient has any of these devices. If the patient cannot write, a picture-word-phrase board or hand signals can be used. The nurse documents which hand is the patient's dominant hand (e.g., used for writing) so that the opposite arm can be used for IV infusions. (To ensure the patient's privacy, the nurse discards notes used for communication.)

Writing everything or communicating through gestures can be very time consuming and frustrating. The patient must be given adequate time to communicate their needs. The patient may become impatient and angry when not understood.

Promoting Adequate Nutrition and Hydration

Postoperatively, the patient may not be permitted to eat or drink for at least 7 days (Kishikova & Fleming, 2014). Alternative sources of nutrition and hydration include IV fluids, enteral feedings through a nasogastric or gastrostomy tube, and parenteral nutrition (see Chapter 15).

When the patient is ready to start oral feedings, a speech therapist or radiologist may conduct a swallow study (a video fluoroscopy radiology procedure) to evaluate the patient's risk of aspiration. Once the patient is cleared for oral feedings, the nurse explains that thick liquids will be used first because they are easy to swallow. Different swallowing maneuvers are attempted with various food consistencies. Once the patient is cleared for food intake, the nurse stays with the patient during initial oral feedings and keeps a suction setup at the bedside

for needed suctioning. The nurse instructs the patient to avoid sweet foods, which increase salivation and suppress the appetite. Solid foods are introduced as tolerated. The patient is instructed to rinse the mouth with warm water or mouthwash after oral feedings and to brush the teeth frequently.

Because taste and smell are so closely related, taste sensations are altered for a while after surgery because inhaled air passes directly into the trachea, bypassing the nose and the olfactory end organs. In time, however, the patient usually accommodates to this change and olfactory sensation adapts, often with return of interest in eating. The nurse observes the patient for any difficulty in swallowing, particularly when eating resumes, and reports its occurrence to the primary provider.

The patient's weight and laboratory data are monitored to ensure that nutritional and fluid intake are adequate. In addition, skin turgor and vital signs are assessed for signs of decreased fluid volume.

Promoting Positive Body Image and Self-Esteem

Disfiguring surgery and an altered communication pattern are threats to a patient's body image and self-esteem. The reaction of family members and friends is a major concern for the patient. The nurse encourages the patient to express feelings about the changes brought about by surgery, particularly feelings related to fear, anger, depression, and isolation.

Promoting Self-Care Management

A positive approach along with promotion of self-care activities is important when caring for the patient. The patient should begin participating in self-care activities as soon as possible. The nurse assesses the patient's readiness for decision making and encourages the patient to participate actively in performing care. The nurse provides positive reinforcement when the patient makes an effort in self-care. The nurse needs to be a good listener and a support to the family, especially when explaining the tubes, dressings, and drains that are in place postoperatively.

Monitoring and Managing Potential Complications

The potential complications after laryngectomy include respiratory distress and hypoxia, hemorrhage, infection, wound breakdown, aspiration, and tracheostomal stenosis.

Respiratory Distress and Hypoxia. The nurse monitors the patient for signs and symptoms of respiratory distress and hypoxia, particularly restlessness, irritation, agitation, confusion, tachypnea, the use of accessory muscles, and decreased oxygen saturation on pulse oximetry (SpO_2). Any change in respiratory status requires immediate intervention. Hypoxia may cause restlessness and an initial rise in blood pressure; this is followed by hypotension and somnolence. Cyanosis is a late sign of hypoxia. Obstruction needs to be ruled out immediately by suctioning and by having the patient cough and breathe deeply. Hypoxia and airway obstruction, if not treated immediately, are life threatening.

Other nursing measures include repositioning of the patient to ensure an open airway and administering oxygen as prescribed. Oxygen is used with caution in patients with chronic obstructive pulmonary disease. The nurse should always be prepared for possible intubation and mechanical ventilation. The nurse must be knowledgeable about the hospital's emergency code protocols and skilled in the use of emergency equipment. The nurse must remain with the patient at all times during respiratory distress and initiate a call to the rapid response team as necessary.

Hemorrhage. Bleeding from the drains at the surgical site or with tracheal suctioning may signal the occurrence of hemorrhage. The nurse promptly notifies the surgeon of any active bleeding, which can occur at a variety of sites, including the surgical site, drains, and trachea. Rupture of the carotid artery is especially dangerous. Should this occur, the nurse must apply direct pressure over the artery, summon assistance, and provide emotional support to the patient until the vessel is ligated. The nurse monitors vital signs for changes, particularly increased pulse rate, decreased blood pressure, and rapid deep respirations. Cold, clammy, pale skin may indicate active bleeding. IV fluids and blood components may be given and other measures implemented to prevent or treat hemorrhagic shock. (Management of the patient with shock is discussed in detail in Chapter 8.)

Infection. The nurse monitors the patient for signs of postoperative infection. These include an increase in temperature and pulse, a change in the type of wound drainage, and increased areas of redness or tenderness at the surgical site. Other signs include purulent drainage, odor, and increased wound drainage. The nurse monitors the patient's white blood cell (WBC) count; a rise in WBCs may indicate the body's effort to combat infection. In older adult patients, infection can be present without an increase in the patient's WBC count; therefore, the nurse must monitor the patient for more subtle signs, such as lethargy, weakness, and decreased appetite. WBCs are suppressed in the patient with decreased immune function (e.g., patients receiving chemotherapy or radiation therapy); this predisposes the patient to a severe infection and sepsis. Antimicrobial (antibiotic) medications must be given as scheduled. All suspicious drainage is cultured, and the patient may be placed on the appropriate infection prevention precautions. Strategies are implemented to minimize the exposure of the patient to microorganisms and their spread to others. The nurse reports any significant change in the patient's status to the surgeon.

Wound Breakdown. Wound breakdown caused by infection, poor wound healing, development of a fistula, radiation therapy, or tumor growth can create a life-threatening emergency. The carotid artery, which is close to the stoma, may rupture from erosion if the wound does not heal properly. The nurse observes the stoma area for wound breakdown, hematoma, and bleeding and reports their occurrence to the surgeon. If wound breakdown occurs, the patient must be monitored carefully and identified as at high risk for carotid hemorrhage.

Aspiration. The patient who has undergone a laryngectomy is at the risk for aspiration and aspiration pneumonia due to depressed cough, the sedating effects of anesthetic and analgesic medications, alteration in the airway, impaired swallowing, and the administration of tube feedings. The nurse assesses for the presence of nausea and administers antiemetic medications, as prescribed. The nurse keeps a suction setup available in the hospital and instructs the family to do so at home for use if needed. Patients receiving tube feedings are positioned with the head of the bed at 30° or higher during feedings and for 30 to 45 minutes after tube feedings. Patients receiving oral feedings are positioned with the head of the bed in an upright position for 30 to 45 minutes after feedings. For patients with a nasogastric or gastrostomy tube, the placement of the tube and residual gastric volume must be checked before each feeding. High amounts of residual volume (greater than 50% of previous intake) indicate delayed gastric emptying; this can lead to reflux and aspiration (Tierney, et al., 2015). Signs or symptoms of aspiration are reported to the primary provider immediately.

Tracheostomal Stenosis. Tracheostomal stenosis is an abnormal narrowing of the trachea or the tracheostomy stoma. Infection at the stoma site, excessive traction on the tracheostomy tube by the connecting tubing, and persistent high tracheostomy cuff pressure are risk factors for tracheostomal stenosis. The incidence of this condition varies widely, and it is often preventable. The nurse assesses the patient's stoma for signs and symptoms of infection and reports any evidence of this to the primary provider immediately. Tracheostomy care is performed routinely. The nurse assesses the connecting tubing (e.g., ventilation tubing) and secures the tubing to avoid excessive traction on the patient's tracheostomy. The nurse ensures that the tracheostomy cuff is deflated (for a patient with a cuffed tube) except for short periods, such as when the patient is eating or taking medications.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. The nurse has an important role in the recovery and rehabilitation of the patient who has had a laryngectomy. To facilitate the patient's ability to manage self-care, discharge instruction begins as soon as the patient is able to participate. Nursing care and patient education in the hospital, outpatient setting, and rehabilitation or long-term care facility must take into consideration the many emotions, physical changes, and lifestyle changes experienced by the patient. In preparing the patient to go home, the nurse assesses the patient's readiness to learn and the level of knowledge about self-care management. The nurse also reassures the patient and family that most self-care management strategies can be mastered. The patient needs to learn a variety of self-care behaviors, including tracheostomy and stoma care, wound care, and oral hygiene. The nurse also instructs the patient about the need for adequate dietary intake, safe hygiene, and recreational activities.

Tracheostomy and Stoma Care. The nurse provides specific instructions to the patient and family about what to expect with a tracheostomy and its management. The nurse instructs the patient and caregiver how to perform suctioning and emergency measures and tracheostomy and stoma care. The nurse stresses the importance of humidification at home and instructs the family to obtain and set up a humidification system before the patient returns home. (See Chapter 11 for details about tracheostomy care.)

Hygiene and Safety Measures. The nurse instructs the patient and family about safety precautions that are needed because of the changes in structure and function resulting from the surgery. Special precautions are needed in the shower to prevent water from entering the stoma. Wearing a loose-fitting plastic bib over the tracheostomy or simply holding a hand over the opening is effective. Swimming is not recommended because a person with a laryngectomy can drown without submerging their face. Barbers and beauticians need to be alerted so that hair sprays, loose hair, and powder do not get near the stoma, because they can block or irritate the trachea and possibly cause infection. These self-care points are summarized in Chart 40-7.

The nurse educates the patient and caregiver about the signs and symptoms of infection and identifies indications that require contacting the primary provider after discharge. A discussion regarding cleanliness and infection control behaviors is essential. The nurse educates the patient and family to use hand hygiene before and after caring for the tracheostomy, to use tissues to remove mucus, and to dispose of soiled dressings and equipment properly. If the patient's surgery included cervical lymph node dissection, the nurse instructs the patient

Chart 40-7 HOME CARE CHECKLIST

The Patient with a Laryngectomy

At the completion of education, the patient and/or caregiver will be able to:

- Name the procedure that was performed and identify any permanent changes in anatomic structure or function as well as changes in ADLs, IADLs, communication, roles, relationships, and spirituality.
- State the name, dose, side effects, frequency, and schedule for all medications.
- Identify interventions and strategies (e.g., durable medical equipment, oxygen, nebulizer, humidifier) used in adapting to any permanent changes in structure or function.
- Describe ongoing postoperative therapeutic regimen, including stoma care, diet, and activities to perform (e.g., shoulder and neck exercises if a node dissection was performed) and to limit or avoid (e.g., swimming and contact sports).
  - Demonstrate tracheostomy care and tracheal suctioning to clear the airway and handle secretions.
  - Explain the rationale for maintaining adequate humidification with a humidifier or nebulizer.
  - Demonstrate how to clean the skin around the stoma and how to use ointments and tweezers to remove encrustations.
  - State the rationale for wearing a loose-fitting protective cloth at the stoma and covering the stoma when showering or bathing.
  - Discuss the need to avoid sprays, powders, particulates, and cold air from air-conditioning and the environment to prevent irritation of the airway.
  - Demonstrate safe technique in changing the laryngectomy/tracheostomy tube.
  - Identify fluid and caloric needs.
  - Describe mouth care and discuss its importance.
  - Identify the signs and symptoms of wound infection and state what to do about them.
  - Describe safety or emergency measures to implement in case of breathing difficulty or bleeding.
  - State the rationale for wearing or carrying special medical identification and ways to obtain help in an emergency.
  - Demonstrate alternative communication methods.
- Relate how to reach primary provider with questions or to report complications.
- State time and date of follow-up appointments.
- Obtain an annual influenza vaccine, and discuss vaccination against pneumonia with the primary provider.
- State understanding of community resources, support groups and referrals (if any).
- Identify the need for health promotion (e.g., weight reduction, smoking cessation, and stress management), disease prevention and screening activities.

Resources

See Procedural Guidelines 11-1: Care of the Patient With a Tracheostomy Tube and Procedural Guidelines 11-2: Performing Tracheal Suction.

ADL, activities of daily living; IADL, independent activities of daily living.

about how to perform exercises to strengthen the shoulder and neck muscles.

Recreation and exercise are important for the patient's well-being and quality of life, and all but very strenuous exercise can be enjoyed safely. Avoidance of strenuous exercise and fatigue is important because the patient will have more difficulty speaking when tired, which can be discouraging. Additional safety points to address include the need for the patient to wear or carry medical identification, such as a bracelet or card, to alert medical personnel to the special requirements for resuscitation should this need arise. If resuscitation is needed, direct mouth-to-stoma ventilation should be performed. For home emergency situations, prerecorded emergency messages for police, the fire department, or other rescue services can be kept near the phone to be used quickly.

The nurse instructs and encourages the patient to perform oral care frequently to prevent halitosis and infection. If the patient is receiving radiation therapy, synthetic saliva may be required because of decreased saliva production. Patients receiving radiation therapy frequently report dry mouth, change in taste, lack of appetite, and mouth sores (Haisfield–Wolfe, Brown, Richardson, et al., 2015) (see Chart 40-8). The nurse instructs the patient to drink water or sugar-free liquids throughout the day and to use a humidifier at home. Brushing the teeth or dentures and rinsing the mouth several times a day will assist in maintaining proper oral hygiene.

Continuing and Transitional Care. Referral for home, community-based, or transitional care is an important aspect of postoperative care for the patient who has had a laryngectomy and will assist the patient and family in the discharge home. The nurse assesses the patient's general health status and the ability of the patient and family to care for the stoma and tracheostomy. The surgical incisions, nutritional and respiratory status, and adequacy of pain management are also assessed. The nurse assesses for signs and symptoms of complications and the patient's and family's knowledge of signs and symptoms to be reported to the physician. During the home visit, the nurse identifies and addresses other learning needs and concerns of the patient and family, such as adaptation to physical, lifestyle, and functional changes, as well as the patient's progress with learning and using new communication strategies. The nurse assesses the patient's psychological status, reinforces previous instructions, and provides reassurance and support to the patient and family caregivers as needed.

The person who has had a laryngectomy should have regular physical examinations and seek advice concerning any problems related to recovery and rehabilitation. The nurse reminds the patient to participate in health promotion activities and health screening and about the importance of keeping scheduled appointments with the physician, speech therapist, and other health care providers.

Evaluation

Expected patient outcomes may include the following:

1. Demonstrates an adequate level of knowledge, verbalizing an understanding of the surgical procedure and performing self-care adequately

Chart 40-8 NURSING RESEARCH PROFILE

Patterns of Symptom Severity of Patients with Cancer of the Head and Neck

Haisfield-Wolfe, M. E., Brown, C., Richardson, M. et al. (2015). Variations in symptom severity patterns among oropharyngeal and laryngeal cancer outpatients during radiation treatment: A pilot study. Cancer Nursing, 38(4), 279–287.

Purpose

Patients diagnosed with laryngeal and oropharyngeal cancer (head and neck cancer [HNC]) commonly receive radiotherapy (RT) treatment on an outpatient basis. Patients with HNC who receive RT treatment commonly experience disturbing symptoms that include pain, difficulty swallowing, dry mouth, change in taste, lack of appetite, and mouth sores. While it is known that these patients tend to experience these symptoms, the patterns and severity of these symptoms are unknown. This pilot study aimed to identify the individual symptom patterns that patients with HNC experience over the course of 6 weeks of RT treatment.

Design

This was a secondary study derived from a parent study that examined symptoms patients with HNC experience when RT therapy is initiated. The study sites included two university-affiliated outpatient cancer centers located in the eastern United States. There were 21 patients with HNC who consented to participate in this study. Eligible participants were at least 18 years of age, with a new diagnosis of HNC, receiving RT treatment, and able to speak and write English. Sampling yielded 21 participants, 5 with laryngeal cancer, and 16 with oropharyngeal cancer. The Memorial Symptom Assessment Scale, a validated and reliable Likert scale survey that measures 32 symptoms associated with cancer treatment, was used to measure participants' symptoms during RT treatment at the time of midtreatment (week 5), end of treatment (week 9), and 6 weeks post-treatment (week 12). Visual graphical analysis was performed to find patterns of symptoms.

Findings

Participants reported variability in symptoms they experienced over time. The most common symptom experienced was pain; peak pain severity was commonly reported by participants, with no detectable pattern based upon study time points. Difficulty swallowing frequently accompanied pain. The other four symptoms of dry mouth, mouth sores, change in taste, and lack of appetite, along with difficulty swallowing, were commonly experienced during midtreatment and at treatment completion. Three patterns were identified. The first pattern noted increase in symptom severity after RT treatment initiation and declined in severity by midtreatment. The second pattern revealed increase in severity of symptoms post-treatment. The last pattern revealed symptom severity that persisted from RT treatment initiation to the post-treatment period. The small sample size precluded conducting inferential statistical analysis.

Nursing Implications

Findings from this study confirm that patients diagnosed with HNC and who receive RT treatment commonly experience the symptoms of pain, difficulty swallowing, dry mouth, change in taste, lack of appetite, and mouth sores. However, patients' symptoms varied in this pilot both in terms of intensity and patterns over the course of RT treatment. Therefore, nurses should assess patients' symptoms and provide individualized plans of care. In particular, participants in this study reported peak pain intensity at different time points during RT treatment, suggesting that patients with HNC require frequent pain assessment, reassessment, and implementation of proactive preventive pain management strategies.

2. Demonstrates less anxiety
   a. Expresses a sense of hope
   b. Is aware of available community organizations and agencies that provide patient education and support groups
   c. Participates in support group for people with a laryngectomy
3. Maintains a clear airway and handles own secretions; also demonstrates practical, safe, and correct technique for cleaning and changing the tracheostomy or laryngectomy tube
4. Acquires effective communication techniques
   a. Uses assistive devices and strategies for communication (Magic Slate, call bell, picture board, sign language, speech reading, handheld electronic devices)
   b. Follows the recommendations of the speech therapist
   c. Demonstrates ability to communicate with new communication strategy
   d. Reports availability of prerecorded messages to summon emergency assistance by telephone
5. Maintains adequate nutrition and adequate fluid intake
6. Exhibits improved body image, self-esteem, and self-concept
   a. Expresses feelings and concerns
   b. Participates in self-care and decision making
   c. Accepts information about support group
7. Adheres to rehabilitation and home care program
   a. Practices recommended speech therapy
   b. Demonstrates proper methods for caring for stoma and laryngectomy or tracheostomy tube (if present)
   c. Verbalizes understanding of symptoms that require medical attention
   d. States safety measures to take in emergencies
   e. Performs oral hygiene as prescribed
8. Absence of complications
   a. Demonstrates a patent airway
   b. No bleeding from surgical site and minimal bleeding from drains; vital signs (blood pressure, temperature, pulse, respiratory rate) are normal
   c. No redness, tenderness, or purulent drainage at surgical site
   d. No wound breakdown
   e. Clear breath sounds; oxygen saturation level within acceptable range; chest x-ray clear
   f. No indications of infection, stenosis, or obstruction of tracheal stoma

CRITICAL THINKING EXERCISES

1. A 20-year-old female college student comes to the student health clinic with complaints of a terrible sore throat with difficulty swallowing and opening her mouth; in addition, she appears to be drooling. She states that she has had a fever lasting several days. What further questions do you have regarding her symptoms? What is your priority focus for your physical examination? What diagnostic tests and treatments may you anticipate?
2. A 65-year-old man presents to the family health clinic for a follow-up visit to check his blood pressure (BP), which has been generally high and difficult to control with antihypertensive medications. The patient is obese, with a body mass index of 38. In addition to his elevated BP, he also reports falling asleep during the day and not feeling like he has slept when he wakes up. You suspect that this patient may have OSA. What risk factors for OSA will your health history focus on? What are the common signs and symptoms of OSA? Describe how a patient with OSA is diagnosed and the treatment(s) that might be prescribed. What is the strength of the evidence that commonly prescribed therapies (such as CPAP) may be effective in alleviating symptoms and improving quality of life for patients with OSA?
3. You are attending a family reunion where a lively game of soccer is taking place. Two players collide and one falls to the ground holding his nose. You suspect that the injured player on the ground has a fractured nose. Briefly describe what you would do in this situation. What are your priority assessments? What are the signs and symptoms of a fractured nose? What are your priority interventions?
4. At the family practice clinic where you work, you are assessing a patient who reports having had a cold about ten days ago. Most of her symptoms have abated, but she is now complaining of a severe headache over the front of her face and a fever of 38.9° C (102° F). She states that the pain increases when she bends over to pick up something off the floor. What further questions do you have regarding her symptoms? What will you focus on during your physical assessment? Briefly, describe the treatment you anticipate could be prescribed for this patient.

REFERENCES

*Asterisk indicates nursing research.

Books

Bickley, L. S., & Szilagyi, P. G. (2013). Bates' guide to physical examination and history taking (11th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

De Vita, V., Hellman, S., & Rosenberg, S. (Eds.). (2014). Cancer: Principles and practice of oncology (10th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Reardon, R. F., Mason, P. E., & Clinton, J. E. (2014). Basic airway management and decision-making. In J. D. Roberts (Ed.): Roberts & Hedges' clinical procedures in emergency medicine (6th ed.). Philadelphia, PA: Elsevier Saunders.

Tierney, L., McPhee, S. J., & Papadakis, M. (Eds.). (2015). Current medical diagnosis and treatment (54th ed.). New York: McGraw-Hill.

Journals and Electronic Documents

Aalia, E. (2014). Total laryngectomy. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/2051731-overview

Aljubran, S. & Lockey, R. F. (2014). Aeroallergens. Retrieved on 3/9/2016 at www.emedicine.medscape.com/article/137911-overview

American Academy of Otolaryngology. (2015). Fact sheet: Sinusitis: Special considerations for aging patients. Retrieved on 10/8/2015 at: www.entnet.org/content/sinusitis-special-considerations-aging-patients

American Cancer Society. (2015). What are the risk factors for laryngeal and hypopharyngeal cancers? Retrieved on 3/9/2016 at: www.cancer.org/Cancer/LaryngealandHypopharyngealCancer

American Sleep Apnea Association. (2015). Obstructive sleep apnea. Available at: www.sleepapnea.org/learn/sleep-apnea/obstructive-sleep-apnea.html

Becker, D. (2014). Nasal and septal fractures. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/878595-overview

Bobdey, S., Jain, A., & Balasubramanium, G. (2015). Epidemiological review of laryngeal cancer: An Indian perspective. Indian Journal of Paediatric oncology, 36(3), 154–160. Retrieved on May18th, 2018 at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4743184/

Brook, I. (2015). Chronic sinusitis. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/232791-overview

Centers for Disease Control and Prevention. (2015). Common colds: Protect yourself and others. Retrieved on 10/12/2015 at: www.cdc.gov/Features/Rhinoviruses/index.html

Downey, R. (2015). Obstructive sleep apnea. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/295807-overview

Drake, A. F., & Carr, M. M. (2015). Tonsillectomy. Retrieved on 3/4/2016 at: reference.medscape.com/article/872119-overview#showall

Fashner, J. Erickson, K., & Werner, S. (2012). Treatment of the common cold in children and adults. American Family Physician, 86(2), 153–159.

Flores, J. (2015). Peritonsillar abscess in emergency medicine. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/764188-overview

*Haisfield-Wolfe, M. E., Brown, C., Richardson, M., et al. (2015). Variations in symptom severity patterns among oropharyngeal and laryngeal cancer outpatients during radiation treatment: A pilot study. Cancer Nursing, 38(4), 279–287.

Karsch-Völk, M., Barrett, B., Kiefer, D., et al. (2014). Echinacea for preventing and treating the common cold. Cochrane Database of Systematic Reviews, Issue 2, CD000530. DOI: 10.1002/14641858.CD000530.pub3

Khan, A. R., & Siddiqui, F. (2020). Regional difference in prevalence of different types of sinusitis at a tertiary care center in Northern India. International Journal of Otorhinolaryngology and Head and Neck Surgery, 6(5), 969–973.

Khanna, S. S., & Gharpure, A. S. (2012). Correlation of increased sinusitis and urban air pollution. International Journal of Science and Research, 1(1), 14-17. Retrieved on May 18th 2018 at http://www.indjsrt.com.

Kishikova, L., & Fleming, J. (2014). Oral feeding following laryngectomy: Early or delayed. International Journal of Surgery, 42(11), 1137–1140.

Krings, J., Kallogjeri, D., Wineland, A., et al. (2014). Complications of primary and revision functional endoscopic sinus surgery for chronic rhinosinusitis. The Laryngoscope, 124(4), 838–845.

Krouse, H., & Krouse, J. (2014). Allergic rhinitis: Diagnosis through management. The Nurse Practitioner, 39(4), 20–28.Lal, D. (2015). Fungal sinusitis. The American Rhinologic Society. Retrieved on 2/28/2016 at: www.care.american-rhinologic.org/fungal_sinusitis

Masand, P. (2012). 1 in 8 Indians hit by Chronic sinusitis: study, Times of India. Retrieved on May 15th, 2018 at https://timesofindia.indiatimes.com/india/1-in-8-Indians-hit-by-chronic-sinusitis-Study/articleshow/12615317.cms

Morgan, C. (2015). Surgical approach to snoring and sleep apnea. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/868770-overview

National Cancer Institute. (2015). Laryngeal cancer treatment (PDQR). Retrieved on 3/9/2016 at: www.cancer.gov/types/head-and-neck/patient/laryngeal-treatment-pdq

National Centre For Disease Informatics & Research (NCDIR) - Indian Council of Medical Research, Annual report,2016-17. Retrieved on 01/30/2018 at http://www.ncdirindia.org/Download/AR_2016_2017.pdf

National Institute of Allergy and Infectious Diseases. (2015). Common cold. Retrieved on 10/12/2015 at: www.niaid.nih.gov/topics/commoncold/Pages/default.aspx

Nguyen, Q. A. (2015). Epistaxis. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/863220-overview

Patel, A. (2014). Functional endoscopic sinus surgery. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/863420-overview

Peppard, P. E., Young, T., Barnet, J. H., et al. (2013). Increased prevalence of sleep-disordered breathing in adults. American Journal of Epidemiology, 177(9), 1006–1014.

Peters, A. (2015). Rhinosinusitis: Synopsis. Retrieved on 10/8/2015 at: www.worldallergy.org/professional/allergic_diseases_center/rhinosinusitis/sinusitissynopsis.php

Randel, A. (2013) IDSA updates: Guideline for managing Group A Streptococcal Pharyngitis. American Family Physician, 88(5), 338–340.

Rosenfeld, R. M., Andes, D., Bhattacharyya, M., et al. (2015). Clinical practice guideline update: Adult sinusitis executive summary. Otolaryngology Head & Neck Surgery, 152(4), 598–609.

Salvaggio, M. R. (2014). Herpes simplex. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/218580-overview

Seidman, M., Gurgel, R. K., Lin, S. Y., et al. (2015). Clinical practice guideline: Allergic Rhinitis: Executive summary. Otolaryngology Head and Neck Surgery, 152(2), 197–206.

Seshamani, M., Vogtmann, E., Gatwood, J., et al. (2014). Prevalence of complications from adult tonsillectomy and impact on health care expenditures. Otolaryngology-Head and Neck Surgery, 150(4), 574–581.

Shah, U. K. (2015). Tonsillitis and peritonsillar abscess: Treatment and management. Retrieved on 3/4/2016 at: emedicine.medscape.com/article/871977-overview#showall

Tewfik, T. (2015). Medical treatment for acute sinusitis. Retrieved on 10/12/2015 at: www.emedicine.medscape.com/article/861646-overview

Viswanathan,V., Ramalingam, I. P., & Nagaraj, R. (2017). Prevalence of sleep apnoea in people with Type 2 Diabetes Mellitus. Journal of Association of Physicians of India, 65, 38–42.

White, D. P., & Shafazand, S. (2013). Mandibular advancement device vs. CPAP in the treatment of obstructive sleep apnea: Are they equally effective in short term health outcomes? Journal of Clinical Sleep Medicine, 9(9), 971–972.

Resources

American Academy of Allergy, Asthma & Immunology (AAAAI), www.aaaai.org

American Academy of Family Physicians, www.aafp.org/home.html

American Academy of Otolaryngology–Head and Neck Surgery, www.entnet.org

American Cancer Society, www.cancer.org

American Lung Association, www.lung.org

American Sleep Apnea Association (ASAA), www.sleepapnea.org/info/index.html

Indian Academy of Otorhinolaryngolgy head and neck surgery, http://iaohns.in/

International Association of Laryngectomees (IAL), www.theial.com/ial/

National Cancer Institute (NCI), www.cancernet.nci.nih.gov

National Center for Disease Informatics and Research-ICMR, www.ncdirindia.org/

National Comprehensive Cancer Network (NCCN), www.nccn.org/about/contact.asp

National Heart, Lung, and Blood Institute (NHBLI), www.nhlbi.nih.gov

National Institute of Allergy and Infectious Diseases (NIAID), www.niaid.nih.gov/Pages/default.aspx

National Sleep Foundation, www.sleepfoundation.org

WebWhispers, www.webwhispers.org

CHAPTER 41

Assessment and Management of Patients with Hearing and Balance Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe the anatomy and physiology of the ear.
2. Explain methods used to assess hearing and balance disorders.
3. List the manifestations that may be exhibited by a person with hearing and balance disorders.
4. Identify ways to communicate effectively with a person with a hearing disorder.
5. Differentiate problems of the external ear from those of the middle ear and inner ear.
6. Compare the various types of surgical procedures used for managing middle ear disorders and appropriate nursing care.
7. Use the nursing process as a framework of care for patients undergoing mastoid surgery.
8. Apply the nursing process as a framework of care for patients with vertigo.
9. Recognize the different types of inner ear disorders, including the clinical manifestations, diagnosis, and management.

GLOSSARY

acute otitis media: inflammation in the middle ear lasting less than 6 weeks
cholesteatoma: tumor of the middle ear or mastoid, or both, that can destroy structures of the temporal bone
chronic otitis media: repeated episodes of acute otitis media causing irreversible tissue damage
conductive hearing loss: loss of hearing in which efficient sound transmission to the inner ear is interrupted by some obstruction or disease process
deafness: partial or complete loss of the ability to hear
dizziness: altered sensation of orientation in space
endolymphatic hydrops: dilation of the endolymphatic space of the inner ear; the pathologic correlate of Ménière disease
exostoses: small, hard, bony protrusions in the lower posterior bony portion of the ear canal
external otitis (i.e., otitis externa): inflammation of the external auditory canal
labyrinthitis: inflammation of the labyrinth of the inner ear
Ménière disease: condition of the inner ear characterized by a triad of symptoms: episodic vertigo, tinnitus, and fluctuating sensorineural hearing loss
middle ear effusion: collection of fluid in the middle ear without evidence of infection
myringotomy (i.e., tympanotomy): incision in the tympanic membrane
nystagmus: involuntary rhythmic eye movement
ossiculoplasty: surgical reconstruction of the middle ear bones to restore hearing
otalgia: sensation of fullness or pain in the ear
otorrhea: drainage from the ear
otosclerosis: a condition characterized by abnormal spongy bone formation around the stapes
presbycusis: progressive hearing loss associated with aging
rhinorrhea: drainage from the nose
sensorineural hearing loss: loss of hearing related to damage to the end organ for hearing or cranial nerve VIII, or both
tinnitus: subjective perception of sound with internal origin; unwanted noises in the head or ear
tympanoplasty: surgical repair of the tympanic membrane
vertigo: illusion of movement in which the individual or the surroundings are sensed as moving

Introduction

The ear is a delicate sensory organ with the dual functions of hearing and balance. The sense of hearing is essential for normal development and maintenance of speech as well as the ability to communicate with others. Balance, or equilibrium, is essential for maintaining body movement, position, and coordination.

The early detection and accurate diagnosis of disorders is necessary for preservation of normal hearing and balance. The diagnosis and treatment of these disorders requires skilled health care professionals such as otolaryngologists, internists, audiologists, and nurses. This chapter provides an overview of the anatomy and physiology of the ear and addresses the general assessment and management of hearing and balance disorders common to adults seen in many health care settings.

ASSESSMENT OF THE EAR

Anatomic and Physiologic Overview

The cranium encloses and protects the brain and surrounding structures, providing attachment for various muscles that control head and jaw movements. The ears are located on either side of the cranium at approximately eye level.

Anatomy of the External Ear

The external ear includes the auricle (pinna) and the external auditory canal (see Fig. 41-1). The external ear is separated from the middle ear by a disc-shaped structure called the *tympanic membrane* (eardrum).

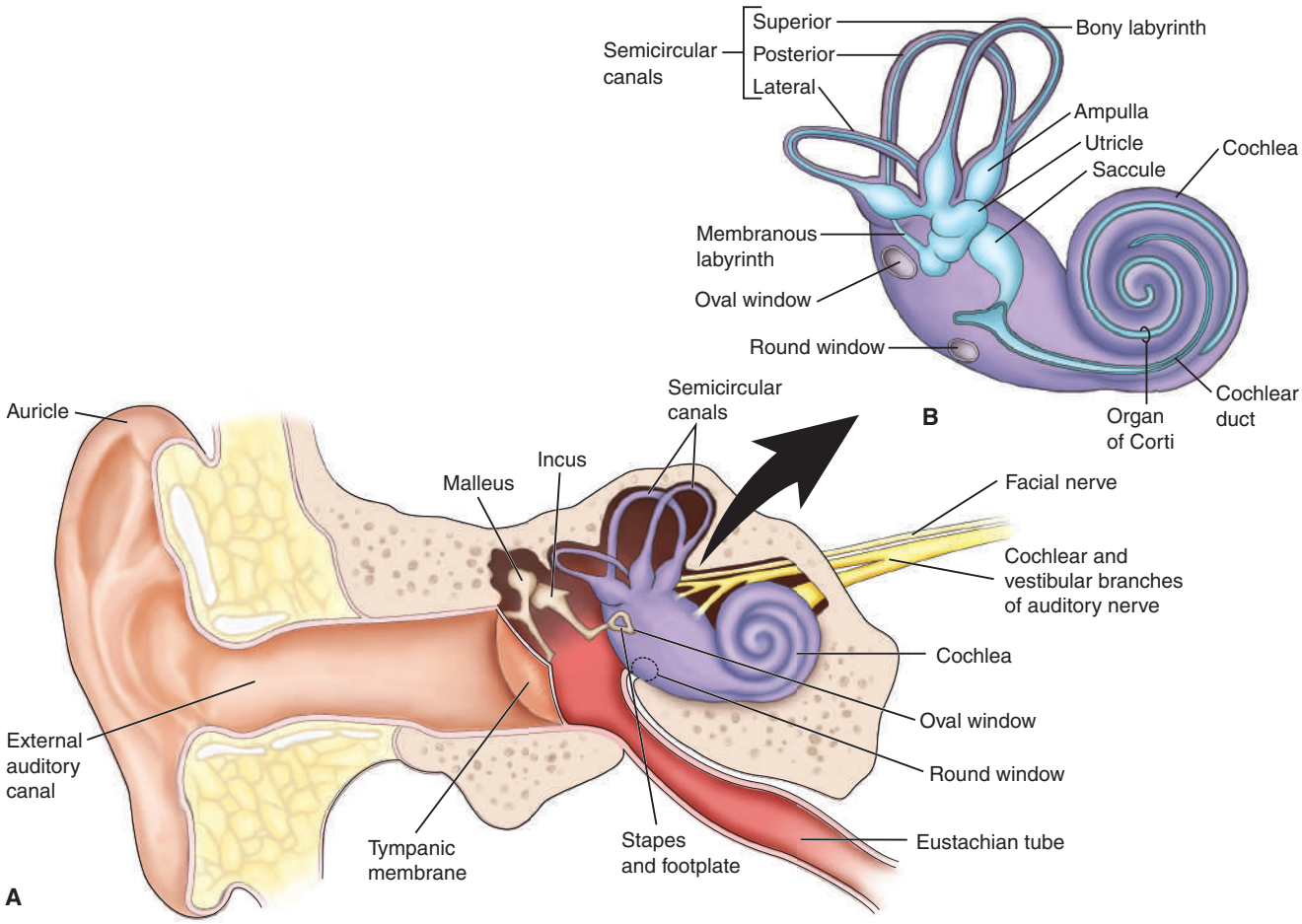


Figure 41-1 • A. Anatomy of the ear. **B.** The inner ear.

Auricle

The auricle, attached to the side of the head by skin, is composed mainly of cartilage, except for the fat and subcutaneous tissue in the earlobe. The auricle collects the sound waves and directs vibrations into the external auditory canal.

External Auditory Canal

The external auditory canal is approximately 2 to 3 cm long (Grossman & Porth, 2014). The lateral third is an elastic cartilaginous and dense fibrous framework to which thin skin is attached. The medial two thirds is bone lined with thin skin. The external auditory canal ends at the tympanic membrane.

The skin of the canal contains hair, sebaceous glands, and ceruminous glands, which secrete a brown, waxlike substance called *cerumen* (ear wax). The ear's self-cleaning mechanism moves old skin cells and cerumen to the outer part of the ear.

Just anterior to the external auditory canal is the temporomandibular joint. The head of the mandible can be felt by placing a fingertip in the external auditory canal while the patient opens and closes the mouth.

Anatomy of the Middle Ear

The middle ear, an air-filled cavity, includes the tympanic membrane laterally and the otic capsule medially. The middle ear cleft lies between the two. The middle ear is connected to the nasopharynx by the eustachian tube and is continuous with air-filled cells in the adjacent mastoid portion of the temporal bone.

The eustachian tube, which is approximately 1 mm wide and 35 mm long, connects the middle ear to the nasopharynx. Normally, the eustachian tube is closed, but it opens by action of the tensor veli palatini muscle when the person performs a Valsalva maneuver, yawns, or swallows. It drains normal and abnormal secretions of the middle ear and equalizes pressure in the middle ear with that of the atmosphere.

Tympanic Membrane

The tympanic membrane (eardrum), about 1 cm in diameter and very thin, is normally pearly gray and translucent (Weber & Kelley, 2014). It consists of three layers of tissue: an outer layer, continuous with the skin of the ear canal; a fibrous middle layer; and an inner mucosal layer, continuous with the lining of the middle ear cavity. Approximately 80% of the tympanic membrane is composed of all three layers and is called the *pars tensa.* The remaining 20% lacks the middle layer and is called the *pars flaccida.* The absence of this fibrous middle layer makes the pars flaccida more vulnerable to pathologic disorders than the pars tensa. Distinguishing landmarks include the annulus, the fibrous border that attaches the eardrum to the temporal bone; the short process of the malleus; the long process of the malleus; the umbo of the malleus, which attaches to the tympanic membrane in the center; the pars flaccida; and the pars tensa (see Fig. 41-2).

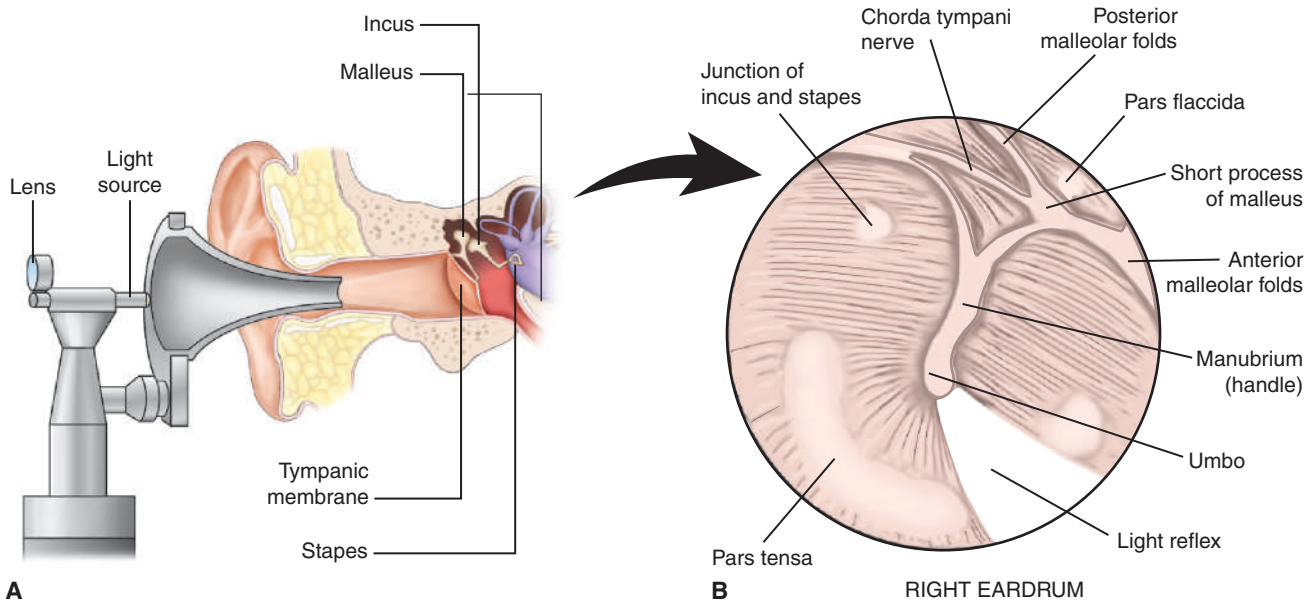


Figure 41-2 • Technique for using the otoscope (**A**) to see the tympanic membrane (**B**).

The tympanic membrane protects the middle ear and conducts sound vibrations from the external canal to the ossicles. The sound pressure is magnified 22 times as a result of transmission from a larger area to a smaller one.

Ossicles

The middle ear contains the three smallest bones (the ossicles) of the body: the malleus, the incus, and the stapes .The ossicles, which are held in place by joints, muscles, and ligaments, assist in the transmission of sound. Two small fenestrae (oval and round windows), located in the medial wall of the middle ear, separate the middle ear from the inner ear. The footplate of the stapes sits in the oval window, secured by a fibrous annulus (ring-shaped structure). The footplate transmits sound to the inner ear. The round window, covered by a thin membrane, provides an exit for sound vibrations (see Fig. 41-1).

Anatomy of the Inner Ear

The inner ear is housed deep within the temporal bone. The organs for hearing (cochlea) and balance (semicircular canals), as well as cranial nerves VII (facial nerve) and VIII (vestibulocochlear nerve), are all part of this complex anatomy (see Fig. 41-1). The cochlea and semicircular canals are housed in the bony labyrinth. The bony labyrinth surrounds and protects the membranous labyrinth, which is bathed in a fluid called *perilymph.*

Membranous Labyrinth

The membranous labyrinth is composed of the utricle, the saccule, the cochlear duct, the semicircular canals, and the organ of Corti, all of which are surrounded by a fluid called *endolymph.* The three semicircular canals—posterior, superior, and lateral, which lie at 90-degree angles to one another—contain sensory receptor organs that are arranged to detect rotational movement. These receptor end organs are stimulated by changes in the rate or direction of a person's movement. The utricle and saccule are involved with linear movements.

Organ of Corti

The organ of Corti is housed in the cochlea, a snail-shaped, bony tube about 3.5 cm long with two and a half spiral turns. Membranes separate the cochlear duct (scala media) from the scala vestibuli and the scala tympani from the basilar membrane. The organ of Corti is located on the basilar membrane that stretches from the base to the apex of the cochlea. As sound vibrations enter the perilymph at the oval window and travel along the scala vestibuli, they pass through the scala tympani, enter the cochlear duct, and cause movement of the basilar membrane. The organ of Corti, also referred to as the end organ for hearing, transforms mechanical energy into neural activity and separates sounds into different frequencies. This electrochemical impulse travels through the acoustic nerve to the temporal cortex of the brain to be interpreted as meaningful sound. In the internal auditory canal, the cochlear (acoustic) nerve, arising from the cochlea, joins the vestibular nerve, arising from the semicircular canals, utricle, and saccule, to become the vestibulocochlear nerve (cranial nerve VIII). This canal also houses the facial nerve and the blood supply from the ear to the brain.

Function of the Ears

Hearing

Hearing is conducted over two pathways: air and bone. Sounds transmitted by air conduction travel over the air-filled external and middle ear through vibration of the tympanic membrane and ossicles. Sounds transmitted by bone conduction travel directly through bone to the inner ear, bypassing the tympanic membrane and ossicles. Normally, air conduction is the more efficient pathway.

Sound Conduction and Transmission

Sound enters the ear through the external auditory canal and causes the tympanic membrane to vibrate. These vibrations transmit sound through the lever action of the ossicles to the oval window as mechanical energy. This mechanical energy is then transmitted through the inner ear fluids to the cochlea, stimulating the hair cells, and is subsequently converted to electrical energy. The electrical energy travels through the vestibulocochlear nerve to the central nervous system, where it is interpreted in its final form as sound.

Vibrations transmitted by the tympanic membrane to the ossicles of the middle ear are transmitted to the cochlea, located in the labyrinth of the inner ear. The stapes rocks, causing vibrations (waves) in fluids contained in the inner ear. These fluid waves cause movement of the basilar membrane, stimulating the hair cells of the organ of Corti in the cochlea to move in a wavelike manner. The movements of the tympanic membrane set up electrical currents that stimulate the various areas of the cochlea. The hair cells set up neural impulses that are encoded and then transferred to the auditory cortex in the brain, where they are decoded into a sound message.

The footplate of the stapes receives impulses transmitted by the incus and the malleus from the tympanic membrane. The round window, which opens on the opposite side of the cochlear duct, is protected from sound waves by the intact tympanic membrane, permitting motion of the inner ear fluids by sound wave stimulation. For example, in the normally intact tympanic membrane, sound waves stimulate the oval window first, and a lag occurs before the terminal effect of the stimulus reaches the round window. However, this lag phase is changed when a perforation of the tympanic membrane allows sound waves to impinge on the oval and round windows simultaneously. This effect cancels the lag and prevents the maximal effect of inner ear fluid motility and its subsequent effect in stimulating the hair cells in the organ of Corti. The result is a reduction in hearing ability (see Fig. 41-3).

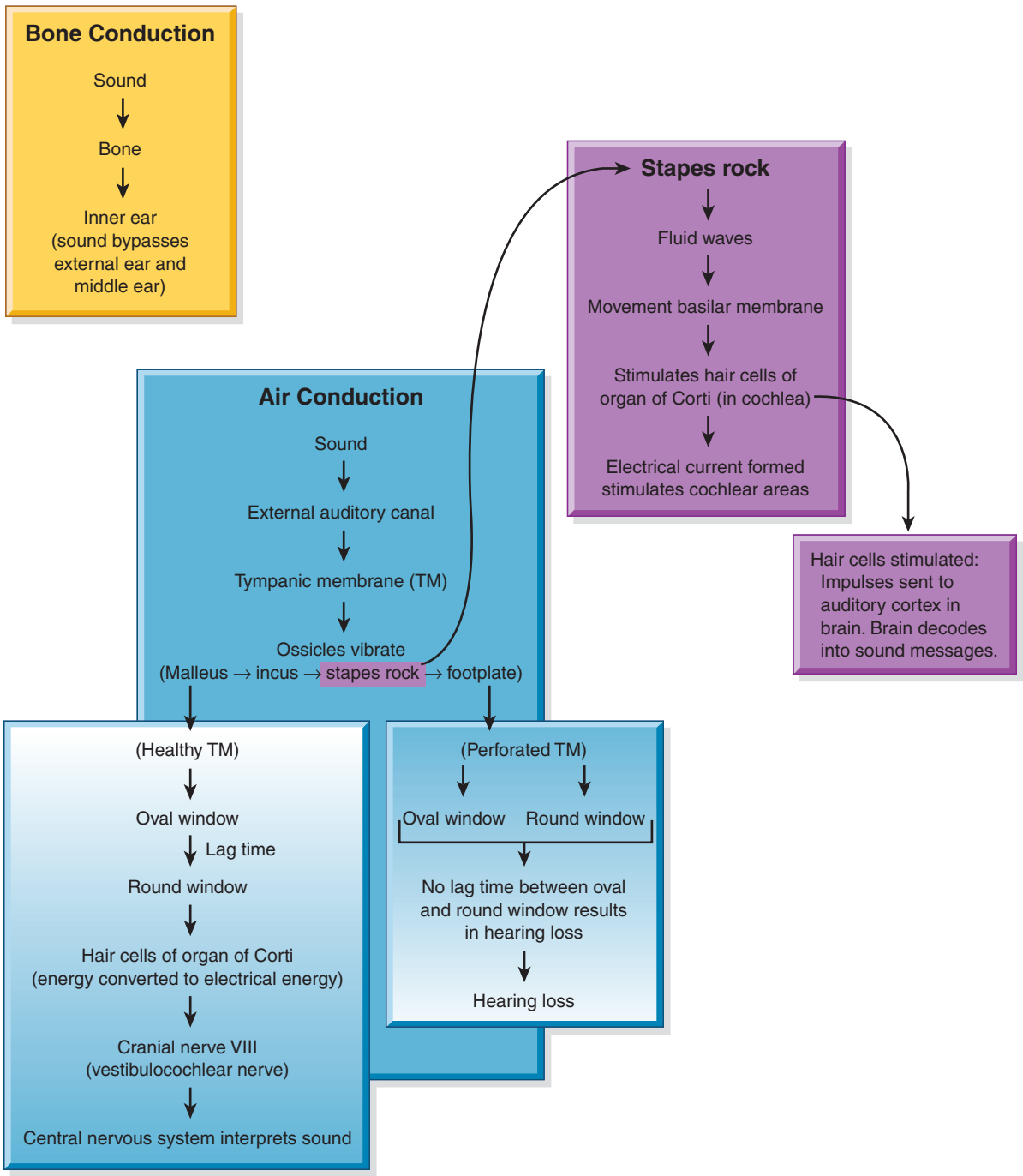


Figure 41-3 • Bone conduction compared to air conduction.

Bone conduction occurs by directly stimulating the bones of the skull that sends sound to the inner ear. An example of how this occurs can be done by striking a tuning fork and placing the tuning fork directly on the skull above the ear. Sound is transmitted to the inner ear.

Balance and Equilibrium

Body balance is maintained by the cooperation of the muscles and joints of the body (proprioceptive system), the eyes (visual system), and the labyrinth (vestibular system). These areas send their information about equilibrium, or balance, to the brain (cerebellar system) for coordination and perception in the cerebral cortex. The brain obtains its blood supply from the heart and arterial system. A problem in any of these areas, such as arteriosclerosis or impaired vision, can cause a disturbance of balance. The vestibular apparatus of the inner ear provides feedback regarding the movements and the position of the head and body in space.

Assessment

Assessment of hearing and balance involves inspection of the external, middle, and inner ear. Evaluation of gross hearing acuity also is included in every physical examination.

Inspection of the External Ear

Inspection of the external ear is a simple procedure, but it is often overlooked. The external ear is examined by inspection and direct palpation; the auricle and surrounding tissues should be inspected for deformities, lesions, and discharge, as well as size, symmetry, and angle of attachment to the head. Manipulation of the auricle does not normally elicit pain. If this maneuver is painful, acute external otitis is suspected (Cash & Glass, 2014). Tenderness on palpation in the area of the mastoid may indicate acute mastoiditis or inflammation of the posterior auricular node. Occasionally, sebaceous cysts and tophi (subcutaneous mineral deposits) are present on the pinna. A flaky scaliness on or behind the auricle usually indicates seborrheic dermatitis and can be present on the scalp and facial structures as well.

Otoscopic Examination

The tympanic membrane is inspected with an otoscope and indirect palpation with a pneumatic otoscope. To examine the external auditory canal and tympanic membrane, the otoscope should be held in the examiner's right hand, in a pencil-hold position, with the examiner's hand braced against the patient's face (see Fig. 41-4). This position prevents the examiner from inserting the otoscope too far into the external canal. Using the opposite hand, the auricle is grasped and gently pulled back to straighten the canal in the adult.

The speculum is slowly inserted into the ear canal, with the examiner's eye held close to the magnifying lens of the otoscope to visualize the canal and tympanic membrane. The largest speculum that the canal can accommodate (usually 5 mm in an adult) is guided gently down into the canal and slightly forward. Because the distal portion of the canal is bony and covered by a sensitive layer of epithelium, only light pressure can be used without causing pain. The external auditory canal is examined for discharge, inflammation, or a foreign body.

The healthy tympanic membrane is pearly gray and is positioned obliquely at the base of the canal. The following landmarks are identified, if visible (see Fig. 41-2): the pars tensa, the umbo, the manubrium of the malleus, and its short process. A slow, circular movement of the speculum allows further visualization of the malleolar folds and periphery. The position and color of the membrane and any unusual markings or deviations from normal are documented. The presence of fluid, air bubbles, blood, or masses in the middle ear also should be noted.

Proper otoscopic examination of the external auditory canal and tympanic membrane requires that the canal be free of large amounts of cerumen. Cerumen is normally present in the external canal, and small amounts should not interfere with otoscopic examination. If the tympanic membrane cannot be visualized because of cerumen, the cerumen may be removed by gently irrigating the external canal with warm water (unless contraindicated). If adherent cerumen is present, a small amount of mineral oil or over-the-counter cerumen softener may be instilled into the ear canal and the patient instructed to

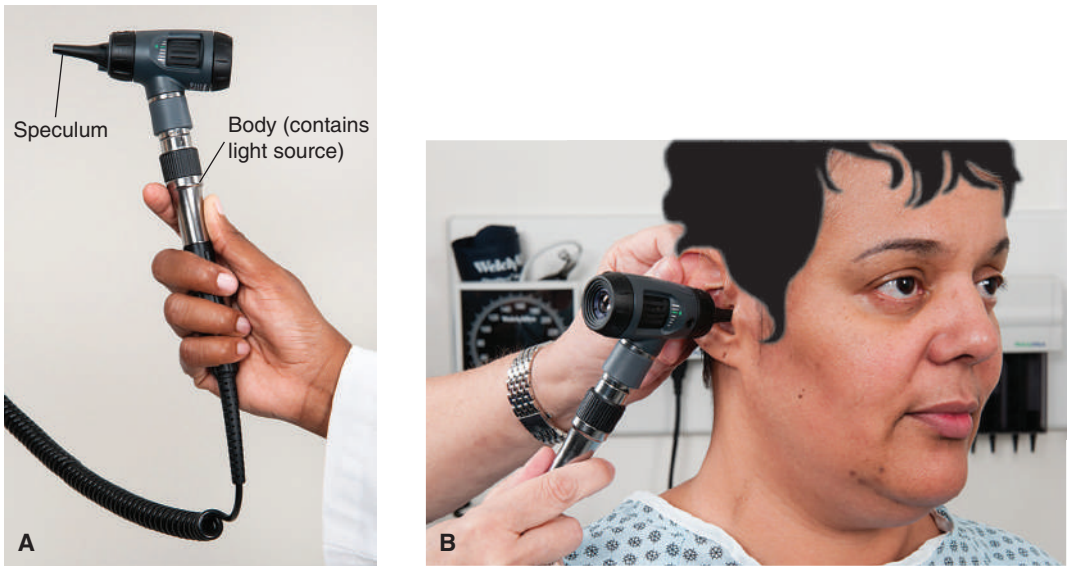


Figure 41-4 • A. The otoscope. **B.** Proper technique for examining the ear. Hold the otoscope in the right or left hand, in a "pencil-hold" position. From Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.



Figure 41-5 • A. The Weber test assesses bone conduction of sound. **B.** The Rinne test assesses both air and bone conduction of sound.

TABLE 41-1 Comparison of Weber and Rinne Tests

Hearing Status	Weber	Rinne
Normal hearing	Sound is heard equally in both ears.	Air conduction is audible longer than bone conduction in both ears.
Conductive hearing loss	Sound is heard best in affected ear (hearing loss).	Sound is heard as long or longer in affected ear (hearing loss).
Sensorineural hearing loss	Sound is heard best in normal hearing ear.	Air conduction is audible longer than bone conduction in affected ear.

Adapted from Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

return for subsequent removal of the cerumen and inspection of the ear. The use of instruments such as a cerumen curette for cerumen removal is reserved for otolaryngologists and nurses with specialized training because of the danger of perforating the tympanic membrane or excoriating the external auditory canal. Cerumen buildup is a common cause of hearing loss and local irritation (Grossman & Porth, 2014).

Evaluation of Gross Auditory Acuity

A general estimate of hearing can be made by assessing the patient's ability to hear a whispered phrase, testing one ear at a time. The Weber and Rinne tests may be used to distinguish conductive loss from sensorineural loss when hearing is impaired (Weber & Kelley, 2014). These tests are part of the usual screening physical examination and are useful if a more specific assessment is needed, if hearing loss is detected, or if confirmation of audiometric results is desired.

Whisper Test

To exclude one ear from the testing, the examiner covers the untested ear with the palm of the hand. The examiner then whispers softly from a distance of 1 or 2 feet from the unoccluded ear and out of the patient's sight. The patient with normal acuity can correctly repeat what was whispered.

Weber Test

The Weber test uses bone conduction to test lateralization of sound. A tuning fork (ideally, 512 Hertz [Hz]), set in motion by grasping it firmly by its stem and tapping it on the examiner's knee or hand, is placed on the patient's head or forehead (see Fig. 41-5A). A person with normal hearing hears the sound equally in both ears or describes the sound as centered in the middle of the head. A person with conductive hearing loss, such as from otosclerosis or otitis media, hears the sound better in the affected ear. A person with sensorineural hearing loss, resulting from damage to the cochlear or vestibulocochlear nerve, hears the sound in the better-hearing ear. The Weber test is useful for detecting unilateral hearing loss (see Table 41-1).

Results of the Weber test are used to determine whether the patient has conductive hearing loss (sounds are heard better in the affected ear) or sensorineural hearing loss (sounds are heard better in the normal ear).

Rinne Test

In the Rinne test (pronounced *rin-ay*), the examiner shifts the stem of a vibrating tuning fork between two positions: 2 inches from the opening of the ear canal (for air conduction) and against the mastoid bone (for bone conduction) (see Fig. 41-5B). As the position changes, the patient is asked to indicate which tone is louder or when the tone is no longer audible.

The Rinne test is useful for distinguishing between conductive and sensorineural hearing loss. A person with normal hearing reports that air-conducted sound is louder than bone-conducted sound. A person with a conductive hearing loss hears bone-conducted sound as long as or longer than air-conducted sound. A person with a sensorineural hearing loss hears air-conducted sound longer than bone-conducted sound.

Diagnostic Evaluation

Many diagnostic procedures are available to measure the auditory and vestibular systems indirectly. These tests are usually performed by a certified audiologist. The nurse educates

the patient about the purpose, what to expect, and any possible side effects related to testing. The nurse notes trends in results because they provide information about disease progression as well as the patient's response to therapy.

Audiometry

In detecting hearing loss, audiometry is the single most important diagnostic instrument. Audiometric testing is of two kinds: pure-tone audiometry, in which the sound stimulus consists of a pure or musical tone (the louder the tone before the patient perceives it, the greater the hearing loss), and speech audiometry, in which the spoken word is used to determine the ability to hear and discriminate sounds and words.

When evaluating hearing, three characteristics are important: frequency, pitch, and intensity. *Frequency* refers to the number of sound waves emanating from a source per second, measured as cycles per second, or Hertz. The normal human ear perceives sounds ranging in frequency from 20 to 20,000 Hz. The frequencies from 500 to 2000 Hz are important in understanding everyday speech and are referred to as the speech range or speech frequencies. *Pitch* is the term used to describe frequency; a tone with 100 Hz is considered of low pitch, and a tone of 10,000 Hz is considered of high pitch.

The unit for measuring loudness (*intensity* of sound) is the decibel (dB), the pressure exerted by sound. Hearing loss is measured in decibels—a logarithmic function of intensity that is not easily converted into a percentage. The critical level of loudness is approximately 30 dB. The shuffling of papers in quiet surroundings is about 15 dB; a low conversation, 40 dB; and a jet plane 100 feet away, about 150 dB. Sound louder than 80 dB is perceived by the human ear to be harsh and can be damaging to the inner ear. Table 41-2 classifies hearing loss based on decibel level. In surgical treatment of patients with hearing loss, the aim is to improve the hearing level to 30 dB or better within the speech frequencies.

With audiometry, the patient wears earphones and signals to the audiologist when a tone is heard. When the tone is applied directly over the external auditory canal, air conduction is measured. When the stimulus is applied to the mastoid bone, bypassing the conductive mechanism (i.e., the ossicles), nerve conduction is tested. For accuracy, testing is performed in a soundproof room. Responses are plotted on a graph known as an audiogram, which differentiates conductive from sensorineural hearing loss.

Tympanogram

A tympanogram, or impedance audiometry, measures middle ear muscle reflex to sound stimulation and compliance of the tympanic membrane by changing the air pressure in a sealed ear canal. Compliance is impaired with middle ear disease.

TABLE 41-2 Severity of Hearing Loss

Loss in Decibels	Interpretation
0–15	Normal hearing
>15–25	Slight hearing loss
>25–40	Mild hearing loss
>40–55	Moderate hearing loss
>55–70	Moderate to severe hearing loss
>70–90	Severe hearing loss
>90	Profound hearing loss

Auditory Brain Stem Response

The auditory brain stem response is a detectable electrical potential from cranial nerve VIII and the ascending auditory pathways of the brain stem in response to sound stimulation. Electrodes are placed on the patient's scalp and on each earlobe (Fischbach & Dunning, 2015). Acoustic stimuli (e.g., clicks) are made in the ear. The resulting electrophysiologic measurements can determine at which decibel level a patient hears and whether there are any impairments along the nerve pathways (e.g., tumor on cranial nerve VIII). Patients are instructed to wash and rinse their hair prior to this study but to avoid applying any other hair product. Auditory brain stem response assessment should be used in conjunction with audiometry for the most accurate results (Bhattacharyya & Meyers, 2015).

Electronystagmography

Electronystagmography is the measurement and graphic recording of the changes in electrical potentials created by eye movements during spontaneous, positional, or calorically evoked nystagmus. It is also used to assess the oculomotor and vestibular systems and their corresponding interaction. It helps to diagnose causes of unilateral hearing loss of unknown origin, vertigo, or tinnitus. Any vestibular suppressants, such as caffeine and alcohol, are withheld for 48 hours before testing. Medications such as tranquilizers, stimulants, or antivertigo agents are withheld for 5 days before the test (Fischbach & Dunning, 2015).

Platform Posturography

Platform posturography is recommended for patients with dizziness and balance disorders (American Academy of Otolaryngology – Head and Neck Surgery, 2014). It can be used to determine if a patient's vertigo is worsening or to evaluate a patient's response to treatment. The integration of visual, vestibular, and proprioceptive cues (i.e., sensory integration) with motor response output and coordination of the lower limbs is tested. The patient stands on a platform, surrounded by a screen, and different conditions such as a moving platform with a moving screen or a stationary platform with a moving screen are presented. The responses from the patient on six different conditions are measured and indicate which of the anatomic systems may be impaired. Preparation for the testing is the same as for electronystagmography.

Sinusoidal Harmonic Acceleration

Sinusoidal harmonic acceleration, or a rotary chair, is used to assess the vestibulo-ocular system by analyzing compensatory eye movements in response to the clockwise and counterclockwise rotation of the chair. Although such testing cannot identify the side of the lesion in unilateral disease, it helps to identify disease (e.g., Ménière disease and tumors of the auditory canal) and evaluate the course of recovery. The same patient preparation is required as that for electronystagmography.

Middle Ear Endoscopy

Using endoscopes with very small diameters and acute angles, the ear can be examined by an endoscopist specializing in otolaryngology. Middle ear endoscopy is performed safely and effectively as an office procedure to evaluate suspected

perilymphatic fistula and new-onset conductive hearing loss, the anatomy of the round window before transtympanic treatment of Ménière disease, and the tympanic cavity before ear surgery to treat chronic middle ear and mastoid infections.

The tympanic membrane is anesthetized topically for about 10 minutes before the procedure. Then, the external auditory canal is irrigated with sterile normal saline solution. With the aid of a microscope, a tympanotomy is created with a laser beam or a myringotomy knife so that the endoscope can be inserted into the middle ear cavity. Video and photo documentation can be accomplished through the scope.

HEARING LOSS

In the United States, hearing impairment has been reported to occur in 2 to 3 of every 1000 births, and approximately one half of the time it is related to genetic factors (U.S. Department of Health and Human Services [HHS], 2016). Genetic syndromes associated with hearing impairment include Waardenburg syndrome, Usher syndrome, Pendred syndrome, and Jervell and Lange-Nielsen syndrome (Antonio, 2016). Chart 41-1 contains more information about hearing disorders that have a genetic cause. There are also acquired causes of hearing loss which may be caused by TORCH infections (TOxoplasmosis, Rubella, Cytomegalovirus, Herpes) during pregnancy as well as trauma or chronic exposure to loud noise (Antonio, 2016). Most hospitals or birthing centers offer universal hearing screenings for newborns after birth and prior to discharge.

All over the world, 432 million adults are suffering from hearing loss. Around 80% people with hearing loss are from low- and middle-income countries (WHO, 2021). Hearing loss occurs in men more often than women. Approximately 2% of adults between the ages of 45 and 54 years have disabling hearing loss. This percentage increases to 8.5% in the 55 to 64 age group, to 25% of adults in the 65 to 74 age group and up to 50% for those over 75 years of age (HHS, 2016). The prevalence of deafness in SouthEast Asian countries ranges from 4.6% to 8.8%. The adult and child-onset deafness prevalence in India was found to be 7.6% and 2% respectively. The preventable deafness attributed by impacted cerumen accounts for 15.9% of the deaf population in India (Varshney, 2016).

Hearing loss is an important health issue, and as people age, hearing screening and treatment are indicated.

Many people are exposed on a daily basis to noise levels that produce high-frequency hearing loss. Occupations such as carpentry, plumbing, and coal mining have the highest risk of noise-induced hearing loss. Wise Ears was developed by the National Institute on Deafness and Other Communication Disorders (NIDCD) and the National Institute for Occupational Safety and Health (NIOSH). It aims to educate the public about noise-induced hearing loss and ways to prevent this hearing loss (NIDCD, 2010).

Conductive hearing loss usually results from an external ear disorder, such as impacted cerumen, or a middle ear disorder, such as otitis media or otosclerosis. In such instances, the efficient transmission of sound by air to the inner ear is interrupted. A sensorineural hearing loss involves damage to the cochlea or vestibulocochlear nerve.

Mixed hearing loss and functional hearing loss also may occur. Patients with mixed hearing loss have conductive loss and sensorineural loss, resulting from dysfunction of air and bone conduction. A functional (or psychogenic) hearing loss is nonorganic and unrelated to detectable structural changes in the hearing mechanisms; it is usually a manifestation of an emotional reaction.

Chart 41-1 GENETICS IN NURSING PRACTICE

Hearing Disorders

Several hearing disorders are associated with genetic abnormalities and have various patterns of inheritance:

Autosomal dominant:
- Branachiootorenal syndrome
- Neurofibromatosis type 2
- Otosclerosis
- Stickler syndrome
- Waardenburg syndrome

Autosomal recessive:
- Connexin 26 gene hearing loss (the majority of cases are recessive; however, there is an autosomal dominant form that occurs less commonly)
- Jervell and Lange-Nielsen syndrome
- Pendred syndrome
- Refsum disease
- Usher syndrome

X-Linked syndromic hearing loss:
- Alport syndrome

Nursing Assessments

Family History Assessment Specific to Hearing Disorders
- Assess for other family members in several generations with hearing loss (autosomal dominant hearing loss).
- Inquire about genetic relatedness (e.g., individuals who are related, such as first cousins, have a higher chance to share the same recessive genes—autosomal recessive hearing loss).
- Inquire about age at onset of hearing loss.

Patient Assessment Specific to Genetic Hearing Disorders
- Assess for:
  - Dizziness
  - Facial numbness or weakness
  - Headaches
  - Tinnitus
- Assess for related genetic conditions, such as vision impairment (e.g., retinitis pigmentosa in Usher syndrome; thyroid disorder in Pendred syndrome).
- Assess for iris, pigment, and hair alterations (white forelock) seen in Waardenburg syndrome.
- Assess for exposure to loud noises (e.g., industrial).
- Assess for presence of rubella, toxoplasmosis, herpes, or cytomegalovirus during pregnancy.
- Determine if patient had taken medications associated with ototoxicity.

Genetics Resources

Hear-It, www.Hear-it.org/Genetic-hearing-loss
Neurofibromatosis Network, www.nfnetwork.org/

Clinical Manifestations

Deafness is the partial or complete loss of the ability to hear. Early manifestations may include tinnitus, increasing inability to hear when in a group, and a need to turn up the volume of the television. Hearing impairment can also trigger changes in attitude, the ability to communicate, the awareness of surroundings, and even the ability to protect oneself, thus affecting a person's quality of life. In a classroom, a student with impaired hearing may be uninterested and inattentive and have failing grades. A person at home may feel isolated because of an inability to hear the clock chime or to hear the telephone. A pedestrian who is hearing impaired may attempt to cross the street and fail to hear an approaching car. People with impaired hearing may miss parts of a conversation. Many people are unaware of their gradual hearing impairment. Often, it is not the person with the hearing loss but the people with whom he or she is communicating who recognizes the impairment first (see Chart 41-2).

For various reasons, some people with hearing loss refuse to seek medical attention or wear a hearing aid. They may feel self-conscious about wearing a hearing aid. Other people, however, may feel comfortable asking those with whom they are trying to communicate to let them know whether difficulties in communication exist. The attitudes and behaviors of patients who need hearing assistance should be taken into account when counseling them. The decision to wear a hearing aid is a personal one that is affected by these attitudes and behaviors.

Chart 41-2 ASSESSING

Hearing Loss

The nurse should be alert to the following:

Speech deterioration: The person who slurs words, drops word endings, or produces flat-sounding speech may not be hearing correctly. The ears guide the voice, both in loudness and in pronunciation.

Fatigue: If a person tires easily when listening to conversation or to a speech, fatigue may be the result of straining to hear. Under these circumstances, the person may become irritable very easily.

Indifference: It is easy for the person who cannot hear what others say to become depressed and disinterested in life in general.

Social withdrawal: Not being able to hear what is going on causes the person who is hearing impaired to withdraw from situations that might prove embarrassing.

Insecurity: Lack of self-confidence and fear of mistakes create a feeling of insecurity in many people who are hearing impaired. No one likes to say the wrong thing or do anything that might appear foolish.

Indecision and procrastination: Loss of self-confidence makes it increasingly difficult for a person who is hearing impaired to make decisions.

Suspiciousness: The person who is hearing impaired—who often hears only part of what is being said—may suspect that others are talking about him or her, or that portions of the conversation are deliberately spoken softly so that he or she will not hear them.

False pride: The person who is hearing impaired wants to conceal the hearing loss and thus often pretends to be hearing when he or she actually is not.

Loneliness and unhappiness: Although everyone wishes for quiet now and then, *enforced* silence can be boring and even somewhat frightening. People with a hearing loss often feel isolated.

Tendency to dominate the conversation: Many people who are hearing impaired tend to dominate the conversation, knowing that as long as it is centered on them and they can control it, they are not so likely to be embarrassed by some mistake.

Prevention

Many environmental factors have an adverse effect on the auditory system and with time result in permanent sensorineural hearing loss. The most common is noise. Noise (unwanted and unavoidable sound) has been identified as one of today's environmental hazards. The volume of noise that surrounds us daily has increased into a potentially dangerous source of physical and psychological damage.

Loud, persistent noise has been found to cause constriction of peripheral blood vessels, increased blood pressure and heart rate (because of increased secretion of adrenalin), and increased gastrointestinal activity. Although research is needed to address the overall effects of noise on the human body, a quiet environment is more conducive to peace of mind. A person who is ill feels more at ease when noise is kept to a minimum.

Numerous factors contribute to hearing loss (see Chart 41-3). *Noise-induced hearing loss* refers to hearing loss that follows a long period of exposure to loud noise (e.g., heavy machinery, engines, artillery, rock-band music). *Acoustic trauma* refers to hearing loss caused by a single exposure to an extremely intense noise, such as an explosion. Usually, noise-induced hearing loss occurs at a high frequency (about 4000 Hz). However, with continued noise exposure, the hearing loss can become more severe and include adjacent frequencies. The minimum noise level known to cause noise-induced hearing loss, regardless of duration, is about 85 to 90 dB.

Noise exposure is inherent in many jobs (e.g., mechanics, printers, pilots, flight attendants, musicians) and in hobbies such as woodworking and hunting. Noise level regulations are based on the amount of noise a person is exposed to, with the maximum legal amount being exposure to noise over an average working day or week of 80 dB, with a peak sound pressure of 135 dB (HHS, 2016). The Occupational Safety and Health Administration (OSHA) requires that workers wear ear protection to prevent noise-induced hearing loss when exposed to noise above the legal limits. Ear protection against noise is the most effective preventive measure available. Hearing loss due to noise is permanent because the hair cells in the organ of Corti are destroyed.

Gerontologic Considerations

With aging, changes occur in the ear that may eventually lead to hearing deficits. Although few changes occur in the external ear, cerumen tends to become harder and drier, posing a greater chance of impaction. In the middle ear, the tympanic membrane may atrophy or become sclerotic. In the inner ear, cells at the base of the cochlea degenerate. A familial predisposition to sensorineural hearing loss is also seen, manifested by inability to hear high-frequency sounds, followed in time by the loss of

Chart 41-3 RISK FACTORS

Hearing Loss

- Family history of sensorineural impairment
- Congenital malformations of the cranial structure (ear)
- Low birth weight (<1500 g)
- Use of ototoxic medications (e.g., gentamycin, loop diuretics)
- Recurrent ear infections
- Bacterial meningitis
- Chronic exposure to loud noises
- Perforation of the tympanic membrane

Chart 41-4 ETHICAL DILEMMA

When Might Someone's Commitment to an Independent Lifestyle Put Himself or Others at Risk?

Case Scenario

You work as a nurse manager in a family practice clinic in the neighborhood where you also live. A 67-year patient tells you that he continues to work full time in a large automotive factory, where he has been employed for the past 40 years. He expresses that he feels incompetent at times and stressed by the noise level. He states, "My boss wants to reassign me from the floor because I can't always hear the alarms when they go off which could cause an accident." He further states, "I think they are just trying to get rid of me because of my age." After reviewing the patient's electronic health record, you find that the patient has a documented history of significant hearing loss. Although he was screened by an audiologist 3 years ago and fitted with hearing aids, he does not wear them.

Discussion

Most adults who have adult onset hearing loss are 65 years of age or older and have been exposed to excessive noise. Hearing loss may put them at risk for injury because they may miss hearing signals that herald changes in the work environment, which could result in injury. Failure to adhere to safety codes and restrictions could also place other employees in the workplace at jeopardy.

Analysis

- Describe the ethical principles that are in conflict in this case (see Chapter 2, Chart 2-3). Which principle should have preeminence as you proceed to work with this patient?
- Is it possible to preserve this patient's autonomy? If so, what steps you might take to ensure that the patient's rights to "self-rule" are maintained?
- The employer recommends a change of workplace environment, which is perceived by the patient as ageism. Are there any indicators of paternalism or ageism in this scenario?

Resources

See Chapter 2, Chart 2-6 for ethics resources.

Adapted from Brock, D. W., Park, J. K., & Wendler, D. (2014). Making treatment decisions for oneself: Weighing the value. The Hastings Center Report, 46(3), 22–30.

middle and lower frequencies. The term presbycusis is used to describe this progressive hearing loss (Eliopoulos, 2018).

In addition to age-related changes, other factors can affect hearing in the older adult population, such as lifelong exposure to loud noises. Certain medications, such as aminoglycosides, aspirin, loop diuretics, and platinum-based antineoplastic medications have ototoxic effects when kidney changes result in delayed medication excretion and increased levels of the medications in the blood.

Psychogenic factors, other disease processes (e.g., diabetes), and medications may be partially responsible for sensorineural hearing loss. The Rights of Person with Disability Bill was passed by Government of India in 2016 which ensures no discrimination for people with 21 different disabilities including deafness (Press information Bureau, Govt of India, 2016). Chart 41-4 describes ethical issues surrounding older adults with hearing loss (Brock, Park, & Wendler, 2014).

Even with the best health care, people with hearing loss must learn to adjust to it. Care of older patients includes recognizing emotional reactions related to hearing loss, such as suspicion of others because of an inability to hear adequately; frustration and anger, with repeated statements such as "I didn't hear what you said!"; and feelings of insecurity because of the inability to hear the telephone or alarms.

Depression, isolation, and a decrease in cognitive function can have a negative impact on quality of life in the older adult with hearing loss. Feelings of social isolation, confusion, alterations in daily living activities, and increasing risk of falls have all been associated with hearing loss in older adults (Mener, Betz, Genther, et al., 2013). Hearing loss can also interfere with relationships due to a loss of communication. A hearing screening is usually recommended as part of the preventive health checkup in most of the hospitals that offer preventive services.

Medical Management

If a hearing loss is permanent or untreatable or if the patient elects not to be treated, aural rehabilitation (discussed at the end of the chapter) may be beneficial.

Nursing Management

Early detection of hearing loss is one of the objectives of (*Healthy People 2020,*) and nurses are in a position to assist in meeting this goal (HHS, 2010). Another objective is for people diagnosed with hearing loss or deafness to use rehabilitation services and supplemental devices to improve communication with other people. Resources are available in workplaces and in schools. Questions used to assess for hearing loss may include:

- Have you experienced any hearing loss in the past?
- Are you experiencing any hearing loss now?
- Do your family members think that you are having difficulty hearing and/or experiencing any hearing loss?

These questions should be included in any routine nursing assessment and referrals made for further evaluation as needed.

Nurses who understand the different types of hearing loss are more successful in adopting a communication style to fit the needs and preferences of each patient. Trying to speak in a loud voice to a person who cannot hear high-frequency sounds only makes understanding more difficult. However, strategies such as talking into the less impaired ear and using gestures and facial expressions can help (see Chart 41-5).

A major issue for many people who are deaf or hearing impaired is that they have other health problems that often do not receive attention, in large part because of communication barriers with their health care providers. To meet the health care needs of these patients, providers are legally obligated to make accommodations for a patient's inability to hear. Providing interpreters for those who can communicate through sign language is essential in many situations so that effective communication occurs.

During health care and screening procedures, the provider (e.g., dentist, physician, nurse) must be aware that patients who are deaf or hearing impaired are unable to read lips, see a signer, or read written materials in the dark rooms required during some diagnostic tests. The same situation exists if the provider is wearing a mask or is not in sight (e.g., x-ray studies, magnetic resonance imaging [MRI], colonoscopy).

Chart 41-5

Communicating with People who are Hearing Impaired

For the Person who is Hearing Impaired whose Speech is Difficult to Understand

- Determine how the person prefers to communicate with others. Do not assume that writing, gestures, or other means are the best or preferred technique.
- Consider if the person uses sign language
- Devote full attention to what the person is saying. Look and listen—do not try to attend to another task while listening.
- Engage the speaker in conversation when it is possible for you to anticipate the replies. This enables you to become accustomed to any peculiarities in speech patterns.
- Try to determine the essential context of what is being said; you can often fill in the details from context.
- Do not try to appear as if you understand if you do not.
- If you cannot understand at all or have serious doubt about your ability to understand what is being said, have the person write the message rather than risk misunderstanding. Having the person repeat the message in speech, after you know its content, also aids you in becoming accustomed to the person's pattern of speech.
- Written communication is an excellent resource. Material should be written at a third-grade level so that the majority of people can understand it.

For the Person who is Hearing Impaired who Speech Reads

- When speaking, always face the person as directly as possible.
- Make sure that your face is as clearly visible as possible. Locate yourself so that your face is well lighted; avoid being silhouetted against strong light. Do not obscure the person's view of your mouth in any way; avoid talking with any object held in your mouth.
- Be sure that the patient knows the topic or subject before going ahead with what you plan to say. This enables the person to use contextual clues in speech reading.
- Speak slowly and distinctly, pausing more frequently than you would normally.
- If you question whether some important direction or instruction has been understood, check to be certain that the patient has the full meaning of your message.
- If for any reason your mouth must be covered (as with a mask) and you must direct or instruct the patient, write the message.

Nurses and other health care providers must work with patients who are deaf or hearing impaired and their families to identify practical and effective means of communication. Nurses can serve as catalysts throughout the health care system to ensure that accommodations are made to meet the communication needs of these patients.

CONDITIONS OF THE EXTERNAL EAR

Cerumen Impaction

Cerumen normally accumulates in the external canal in various amounts and colors. Although wax does not usually need to be removed, impaction occasionally occurs, causing otalgia (a sensation of fullness or pain in the ear) with or without a hearing loss. Accumulation of cerumen as a cause of hearing loss is especially significant in older adult patients (Eliopoulos, 2018). Attempts to clear the external auditory canal with matches, hairpins, and other implements are dangerous because trauma to the skin, infection, and damage to the tympanic membrane can occur.

Management

Cerumen can be removed by irrigation, suction, or instrumentation. Unless the patient has a perforated eardrum or an inflamed external ear (i.e., otitis externa), gentle irrigation with warm water usually helps remove impacted cerumen, particularly if it is not tightly packed in the external auditory canal. For successful removal, the water stream must flow behind the obstructing cerumen to move it first laterally and then out of the canal. To prevent injury, the lowest effective pressure should be used. However, if the eardrum behind the impaction is perforated, water can enter the middle ear, producing acute vertigo and infection. If irrigation is unsuccessful, direct visual, mechanical removal can be performed by a trained health care provider on a patient who is cooperative.

Nursing Alert: Warm water (never cold or hot) and gentle (not forceful) irrigation should be used to remove cerumen. Irrigation that is too forceful can cause perforation of the tympanic membrane, and ice water causes vomiting.

Instilling a few drops of warmed glycerin, mineral oil, or half-strength hydrogen peroxide into the ear canal for 30 minutes prior to irrigation can soften cerumen before its removal. Ceruminolytic agents, such as peroxide in glyceryl (Debrox), are available. The use of any softening solution two or three times a day for several days is generally sufficient. If the cerumen cannot be dislodged by these methods, instruments, such as a cerumen curette, aural suction, and a binocular microscope for magnification, can be used.

Foreign Bodies

Some objects are inserted intentionally into the ear by adults who may have been trying to clean the external canal or relieve itching, or by children who introduce peas, beans, pebbles, toys, and beads. Insects may also enter the ear canal. In either case, the effects may range from no symptoms to profound pain and decreased hearing.

Management

Removing a foreign body from the external auditory canal can be quite challenging. The three standard methods for removing foreign bodies are the same as those for removing cerumen: irrigation, suction, and instrumentation. The contraindications for irrigation are also the same. Foreign vegetable bodies and insects tend to swell; thus, irrigation is contraindicated. Usually, an insect can be dislodged by instilling mineral oil, which will kill the insect and allow it to be removed.

Attempts to remove a foreign body from the external canal may be dangerous in unskilled hands. The object may be pushed completely into the bony portion of the canal, lacerating the skin and perforating the tympanic membrane. In rare circumstances,

the foreign body may have to be extracted in the operating room with the patient under general anesthesia.

External Otitis (Otitis Externa)

External otitis (i.e., otitis externa), refers to an inflammation of the external auditory canal. Causes include water in the ear canal (swimmer's ear); trauma to the skin of the ear canal, permitting entrance of organisms into the tissues; and systemic conditions, such as vitamin deficiency and endocrine disorders. Bacterial or fungal infections are most frequently encountered. The most common bacterial pathogens associated with external otitis are *Staphylococcus aureus* and *Pseudomonas* species. The most common fungus isolated in both normal and infected ears is *Aspergillus* (Grossman & Porth, 2014). External otitis is often caused by a dermatosis such as psoriasis, eczema, or seborrheic dermatitis. Even allergic reactions to hair spray, hair dye, and permanent wave lotions can cause dermatitis, which clears when the offending agent is removed.

Clinical Manifestations

Patients usually report pain; discharge from the external auditory canal; aural tenderness (usually not present in middle ear infections); and occasionally fever, cellulitis, and lymphadenopathy. Other symptoms may include pruritus and hearing loss or a feeling of fullness in the ear. On otoscopic examination, the ear canal is erythematous and edematous. Discharge may be yellow or green and foul smelling. In fungal infections, hairlike black spores may be visible.

Medical Management

The principles of therapy are aimed at relieving the discomfort, reducing the swelling of the ear canal, and eradicating the infection. Patients may require analgesic medications for the first 48 to 96 hours. Treatment most often includes antimicrobial or antifungal otic medications given by dropper at room temperature. In bacterial infection, a combination antibiotic and corticosteroid agent may be used to soothe the inflamed tissues (Grossman & Porth, 2014).

Nursing Management

Nurses should instruct patients not to clean the external auditory canal with cotton-tipped applicators and to avoid events that traumatize the external canal, such as scratching the canal with the fingernail or other objects. Trauma may lead to infection of the canal. Patients should also avoid getting the canal wet when swimming or shampooing the hair. A cotton ball or lamb's wool can be covered in a water-insoluble gel such as petrolatum jelly and placed in the ear as a barrier to the canal getting wet. Infection can be prevented by using antiseptic otic preparations after swimming (e.g., Swim-Ear, Ear Dry), unless there is a history of tympanic membrane perforation or a current ear infection (see Chart 41-6).

Malignant External Otitis

A more serious, although rare, external ear infection is malignant external otitis (temporal bone osteomyelitis). This is a progressive, debilitating, and occasionally fatal infection of the external auditory canal, the surrounding tissue, and the base of the skull. *Pseudomonas aeruginosa* is usually the infecting organism in patients with low resistance to infection (e.g., patients with acquired immune deficiency virus). Successful treatment includes administration of antibiotics (usually intravenously [IV]), and aggressive local wound care. Standard parenteral antibiotic treatment includes the combination of an antipseudomonal agent and an aminoglycoside, both of which have potentially serious side effects. Because aminoglycosides are nephrotoxic and ototoxic, serum aminoglycoside levels and kidney and auditory function must be monitored during therapy. Local wound care includes limited débridement of the infected tissue, including bone and cartilage, depending on the extent of the infection.

Chart 41-6 PATIENT EDUCATION

Prevention of Otitis Externa

The nurse instructs the patient to:

- Protect the external canal when swimming, showering, or washing hair. Use ear plugs or place a cotton ball covered in petrolatum jelly in the ear, and wear a swim cap. The external canal may be dried afterward with a hair dryer on low heat.
- Place alcohol drops in the external canal to act as an astringent to help prevent infection after water exposure.
- Prevent trauma to the external canal. Procedures, foreign objects (e.g., bobby pin), scratching, or any other trauma to the canal that breaks the skin integrity may cause infection.
- Be aware that if otitis externa is diagnosed, refrain from any water sport activity for approximately 7–10 days to allow the canal to heal completely. Recurrence is highly likely unless you allow the external canal to heal completely.

Masses of the External Ear

Exostoses are small, hard, bony protrusions found in the lower posterior bony portion of the ear canal; they usually occur bilaterally. The skin covering the exostosis is normal. It is believed that exostoses are caused by an exposure to cold water, as in scuba diving or surfing. The usual treatment, if any, is surgical excision.

Malignant tumors also may occur in the external ear. Most common are basal cell carcinomas on the pinna and squamous cell carcinomas in the ear canal. If untreated, squamous cell carcinoma may spread through the temporal bone, causing facial nerve paralysis and hearing loss. Carcinomas must be treated surgically.

Deformities of the External Ear

External ear or auricle gathers the sound waves and directs it toward the ear drum for better hearing and differentiation of voices. Other than that it also gives an esthetic appeal to the face. Babies born with external ear abnormality experience psychological distress.

Deformities of the external ear are either due to total absence or malformation of the skin and cartilaginous tissue of the auricle. Hearing loss may be present along with external ear deformities.

Following are some of the defects in external ear:

- **Anotia:** Absence of external ear.
- **Microtia:** It is a condition in which ear lobe is underdeveloped and there is absence of skin or cartilage. It may be associated with middle ear abnormality leading to hearing loss (Bhatti et al., 2021). It may also be associated

with vertebral abnormality, oral cleft, facial asymmetry, renal or cardiac defects, microphthalmia, etc.

- **Cryptotia:** It is otherwise known as hidden ear. The superior one-third of the cartilage may be malformed and gets buried underneath the skin.
- **Stahl ear:** There may be presence of additional abnormal vertical cartilage band crossing the scaphoid fossa giving the ear a pointed appearance. It gives an elflike appearance.
- **Constricted ear:** The superior one-third of the cartilage is developed with deformity. There are four different types namely lidded ear, lop ear, canoe ear, and cockle shell ear (Bhatti et al., 2021).
- **Prominent ear:** The external ear may project more than 2 cm from the side of the head with large surface area. Underdeveloped antihelix or overdeveloped conchal bowl or both can lead to prominent ear.
- **Preauricular anomalies:** They are ear anomalies with remnant ectopic cartilage or sinus. The sinus or ectopic cartilage does not have any functional problem. These anomalies have esthetic implication as the cartilage does not regress over time. The sinus may get infected at times which warrants antibiotic treatment or surgical repair.

Management

If recognized early, the abnormalities can be corrected with surgery or repositioning. For some conditions, moulds may be used.

CONDITIONS OF THE MIDDLE EAR

Tympanic Membrane Perforation

Perforation of the tympanic membrane is usually caused by infection or trauma. Sources of trauma include skull fracture, injury from explosion, or a severe blow to the ear. Less frequently, perforation is caused by foreign objects (e.g., cotton-tipped applicators, hairpins, keys) that have been pushed too far into the external auditory canal. In addition to tympanic membrane perforation, injury to the ossicles and even the inner ear may result from this type of trauma. During infection, the tympanic membrane can rupture if the pressure in the middle ear exceeds the atmospheric pressure in the external auditory canal.

Medical Management

Although most tympanic membrane perforations heal spontaneously within weeks after rupture, some may take several months to heal. Some perforations persist because scar tissue grows over the edges of the perforation, preventing extension of the epithelial cells across the margins and final healing. In the case of a head injury or temporal bone fracture, a patient is observed for evidence of cerebrospinal fluid otorrhea or rhinorrhea—a clear, watery drainage from the ear or nose, respectively. While healing, the ear must be protected from water getting into the ear canal.

Surgical Management

Perforations that do not heal on their own may require surgery. The decision to perform a tympanoplasty (see later section in this chapter) is usually based on the need to prevent potential infection from water entering the ear or the desire to improve the patient's hearing. Performed on an outpatient basis, tympanoplasty may involve a variety of surgical techniques. In all techniques, tissue (commonly from the temporalis fascia) is placed across the perforation to allow healing. Surgery is usually successful in closing the perforation permanently and improving hearing.

Acute Otitis Media

Ear infections can occur at any age; however, they are most commonly seen in children. Acute otitis media (AOM) is an acute infection of the middle ear, lasting less than 6 weeks. Pathogens that cause AOM are usually bacterial or viral and enter the middle ear after eustachian tube dysfunction caused by obstruction related to upper respiratory infections, inflammation of surrounding structures (e.g., rhinosinusitis, adenoid hypertrophy), or allergic reactions (e.g., allergic rhinitis) (Grossman & Porth, 2014). Bacteria can enter the eustachian tube from contaminated secretions in the nasopharynx and the middle ear from a tympanic membrane perforation. A purulent exudate is usually present in the middle ear, resulting in a conductive hearing loss.

Clinical Manifestations

Symptoms of otitis media vary with the severity of the infection. The condition, usually unilateral in adults, may be accompanied by otalgia. The pain is relieved after spontaneous perforation or therapeutic incision of the tympanic membrane. Other symptoms may include drainage from the ear, fever, and hearing loss. Table 41-3 differentiates acute otitis externa from AOM. Risk factors for AOM include younger age, chronic upper respiratory infections, medical conditions that predispose the patient to ear infections (e.g., Down syndrome, cystic fibrosis, cleft palate), and chronic exposure to secondhand cigarette smoke.

Medical Management

The outcome of AOM depends on the efficacy of therapy (the prescribed dose of an oral antibiotic and the duration of therapy), the virulence of the bacteria, and the physical status of the patient. With early and appropriate broad-spectrum antibiotic therapy, otitis media may resolve with no serious sequelae. If drainage occurs, an antibiotic otic preparation is usually prescribed. The condition may become subacute (lasting 2 weeks to 3 months),

TABLE 41-3 Clinical Features of Otitis

Feature	Acute Otitis Externa	Acute Otitis Media
Otorrhea	May or may not be present	Present if tympanic membrane perforates; discharge is profuse.
Otalgia	Persistent; may awaken patient at night	Relieved if tympanic membrane ruptures
Aural tenderness	Present on palpation of auricle	Usually absent
Systemic symptoms	Absent	Fever, upper respiratory infection, rhinitis
Edema of external auditory canal	Present	Absent
Tympanic membrane	May appear normal	Erythema, bulging, may be perforated
Hearing loss	Conductive type	Conductive type

with persistent purulent discharge from the ear. Rarely does permanent hearing loss occur. Secondary complications involving the mastoid and other serious intracranial complications, such as meningitis or brain abscess, although rare, can occur.

Surgical Management

A myringotomy (i.e., tympanotomy) is an incision in the tympanic membrane. The tympanic membrane is numbed with a local anesthetic agent such as phenol or by iontophoresis (i.e., in which electrical current flows through a lidocaine and epinephrine solution to numb the ear canal and tympanic membrane). The procedure is painless and takes less than 15 minutes. Under microscopic guidance, an incision is made through the tympanic membrane to relieve pressure and to drain serous or purulent fluid from the middle ear.

Normally, this procedure is unnecessary for treating AOM, but it may be performed if pain persists. Myringotomy also allows the drainage to be analyzed (by culture and sensitivity testing) so that the infecting organism can be identified and appropriate antibiotic therapy prescribed. The incision heals within 24 to 72 hours.

If AOM recurs and there is no contraindication, a ventilating, or pressure-equalizing, tube may be inserted. The ventilating tube, which temporarily takes the place of the eustachian tube in equalizing pressure, is retained for 6 to 18 months. The ventilating tube is then extruded with normal skin migration of the tympanic membrane, with the hole healing in nearly every case. Ventilating tubes are used to treat recurrent episodes of AOM.

Serous Otitis Media

Serous otitis media is one of the important cause of deafness among Indians contributing for 3% of people with deafness (Varshney, 2016). Middle ear effusion, or serous otitis media, involves the presence of fluid, without evidence of active infection, in the middle ear. In theory, this fluid results from a negative pressure in the middle ear caused by eustachian tube obstruction. When this condition occurs in adults, an underlying cause for the eustachian tube dysfunction must be sought. Middle ear effusion is frequently seen in patients after radiation therapy or barotrauma and in patients with eustachian tube dysfunction from a concurrent upper respiratory infection or allergy. Barotrauma results from sudden pressure changes in the middle ear caused by changes in barometric pressure, as in scuba diving or airplane descent. A carcinoma (e.g., nasopharyngeal cancer) obstructing the eustachian tube should be ruled out in adults with persistent unilateral serous otitis media.

Clinical Manifestations

Patients may complain of hearing loss, fullness in the ear or a sensation of congestion, or popping and crackling noises that occur as the eustachian tube attempts to open. The tympanic membrane appears dull on otoscopy, and air bubbles may be visualized in the middle ear. Usually, the audiogram shows a conductive hearing loss.

Management

Serous otitis media need not be treated medically unless infection (i.e., AOM) occurs. If the hearing loss associated with middle ear effusion is significant, a myringotomy can be performed, and a tube may be placed to keep the middle ear ventilated. Corticosteroids in small doses may decrease the edema of the eustachian tube in cases of barotrauma. Decongestants have not proved to be effective. A Valsalva maneuver, which forcibly opens the eustachian tube by increasing nasopharyngeal pressure, may be cautiously performed; this maneuver may cause worsening pain or perforation of the tympanic membrane.

Chronic Otitis Media

Chronic otitis media ranks third as the cause of deafness among Indian population (Varshney, 2016). Chronic otitis media is recurrent AOM that causes irreversible tissue pathology. Chronic infections of the middle ear damage the tympanic membrane, destroy the ossicles, and involve the mastoid but are rare in developed countries.

Clinical Manifestations

Symptoms may be minimal, with varying degrees of hearing loss and a persistent or intermittent, foul-smelling otorrhea. Pain is not usually experienced, except in cases of acute mastoiditis, when the postauricular area is tender and may be erythematous and edematous. Otoscopic examination may show a perforation, and cholesteatoma can be identified as a white mass behind the tympanic membrane or coming through to the external canal from a perforation.

Cholesteatoma is a tumor of the external layer of the eardrum into the middle ear. It is generally caused by a chronic retraction pocket of the tympanic membrane, creating a persistently high negative pressure of the middle ear. The skin forms a sac that fills with degenerated skin and sebaceous materials. The sac can attach to the structures of the middle ear, mastoid, or both.

Chronic otitis media can cause chronic mastoiditis and lead to the formation of cholesteatoma. It can occur in the middle ear, mastoid cavity, or both, often dictating the type of surgery to be performed. If untreated, cholesteatoma will continue to enlarge, possibly causing damage to the facial nerve and horizontal canal and destruction of other surrounding structures.

Cholesteatomas are cystlike lesions of the inner ear (Grossman & Porth, 2014). They usually do not cause pain; however, if treatment or surgery is delayed, they may burst or destroy the mastoid bone. These fast-growing lesions may cause severe sequelae such as hearing loss. Cholesteatomas found in older adult patients generally develop in the external canal.

Cholesteatomas may be asymptomatic, or they may cause hearing loss, facial pain and paralysis, tinnitus, or vertigo. Audiometric tests often show a conductive or mixed hearing loss. Based on presenting symptoms, diagnosis may be made by visual examination or by computed tomography (CT) or MRI scan. Therapy includes treatment of the acute infection and surgical removal of the mass to restore hearing.

Medical Management

Local treatment for chronic otitis media consists of careful suctioning of the ear under otoscopic guidance. Instillation of antibiotic drops or application of antibiotic powder is used to treat purulent discharge. Systemic antibiotic agents are prescribed only in cases of acute infection.

Surgical Management

Surgical procedures, including tympanoplasty, ossiculoplasty, and mastoidectomy, are used if medical treatments are ineffective.

Tympanoplasty

The most common surgical procedure for chronic otitis media is tympanoplasty, or surgical reconstruction of the tympanic membrane. Reconstruction of the ossicles may also be required. The purposes of a tympanoplasty are to reestablish middle ear function, close the perforation, prevent recurrent infection, and improve hearing.

There are five types of tympanoplasties. The simplest surgical procedure, type I (myringoplasty), is designed to close a perforation in the tympanic membrane. The other procedures, types II through V, involve more extensive repair of middle ear structures. The structures and the degree of involvement can differ, but all tympanoplasty procedures include restoring the continuity of the sound conduction mechanism.

Tympanoplasty is performed through the external auditory canal with a transcanal approach or through a postauricular incision. The contents of the middle ear are carefully inspected, and the ossicular chain (malleus and incus unit) is evaluated. Ossicular interruption is most frequent in chronic otitis media, but problems of reconstruction can also occur with malformations of the middle ear and ossicular dislocations due to head injuries. Dramatic improvement in hearing can result from closure of a perforation and reestablishment of the ossicles. Surgery is usually performed in an outpatient facility under moderate sedation or general anesthesia.

Ossiculoplasty

Ossiculoplasty is the surgical reconstruction of the middle ear bones to restore hearing. Prostheses made of materials such as Teflon, stainless steel, and hydroxyapatite are used to reconnect the ossicles, thereby reestablishing the sound conduction mechanism. However, the greater the damage, the lower the success rate for restoring normal hearing.

Mastoidectomy

The objectives of mastoid surgery are to remove the cholesteatoma, gain access to diseased structures, and create a dry (noninfected) and healthy ear. If possible, the ossicles are reconstructed during the initial surgical procedure. Occasionally, extensive disease or damage dictates that this be performed as part of a two-stage operation.

A mastoidectomy is usually performed through a postauricular incision. Infection is eliminated by removing the mastoid air cells. A second mastoidectomy may be necessary to check for recurrent or residual cholesteatoma. The hearing mechanism may be reconstructed at this time. The success rate for correcting this conductive hearing loss is approximately 75%. Surgery is usually performed in an outpatient setting. The patient has a mastoid pressure dressing, which can be removed 24 to 48 hours after surgery. Although infrequently injured, the facial nerve, which runs through the middle ear and mastoid, is at some risk for injury during mastoid surgery. As the patient awakens from anesthesia, any evidence of facial paresis should be reported to the primary provider.

NURSING PROCESS

The Patient Undergoing Mastoid Surgery

Although several otologic surgical procedures are performed under moderate sedation, mastoid surgery is performed using general anesthesia.

Assessment

The health history includes a complete description of the ear disorder, including infection, otalgia, otorrhea, hearing loss, and vertigo. Data are collected about the duration and intensity of the disorder, its causes, and previous treatments. Information is obtained about other health problems and all medications that the patient is taking. Medication allergies and family history of ear disease also should be obtained.

Physical assessment addresses erythema, edema, otorrhea, lesions, and characteristics such as odor and color of discharge. The results of the audiogram are reviewed.

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Anxiety related to surgical procedure, potential loss of hearing, potential taste disturbance, and potential loss of facial movement
- Acute pain related to mastoid surgery
- Risk for infection related to mastoidectomy; placement of grafts, prostheses, and electrodes; and surgical trauma to surrounding tissues and structures
- Impaired verbal communication related to ear disorder, surgery, or packing
- Risk for injury related to impaired balance or vertigo during the immediate postoperative period, dislodgment of the graft or prosthesis, or injury to facial nerve (cranial nerve VII) and chorda tympani nerve
- Deficient knowledge about mastoid disease, surgical procedure, and postoperative care and expectations

Planning and Goals

The major goals of caring for a patient undergoing mastoidectomy include reduction of anxiety; freedom from pain and discomfort; prevention of infection; stable or improved hearing and communication; absence of vertigo and related injury; and increased knowledge regarding the disease, surgical procedure, and postoperative care.

Nursing Interventions

Reducing Anxiety

The nurse reinforces the information discussed by the otologic surgeon with the patient, including anesthesia, the location of the incision (postauricular), and expected surgical results (e.g., hearing, balance, taste, facial movement). The patient also is encouraged to discuss any anxieties and concerns about the surgery.

Relieving Pain

Although most patients complain very little about incisional pain after mastoid surgery, they do have some ear discomfort. Aural fullness or pressure after surgery is caused by residual blood or fluid in the middle ear. The prescribed analgesic medication may be taken for the first 24 hours after surgery and then only as needed.

A wick or external auditory canal packing is used if tympanoplasty was performed at the time of the mastoidectomy. For the next 2 to 3 weeks after surgery, the patient may experience sharp, shooting pains intermittently as the eustachian tube opens and allows air to enter the middle ear. Constant, throbbing pain accompanied by fever may indicate infection and should be reported to the primary provider.

Preventing Infection

Measures are initiated to prevent infection in the operated ear. The external auditory canal wick, or packing, may be impregnated with an antibiotic solution before instillation. Prophylactic antibiotic agents are given as prescribed, and the patient is instructed to prevent water from entering the external auditory canal for 6 weeks. A cotton ball or lamb's wool covered with a water-insoluble substance (e.g., petrolatum jelly) and placed loosely in the ear canal usually prevents water from entering the ear canal and should be used when the patient showers or washes their hair, or in any situations in which water may enter the ear canal. The postauricular incision should be kept dry for the first 2 days. Signs of infection such as an elevated temperature and purulent drainage should be reported. Some serosanguineous drainage from the external auditory canal is normal after surgery.

Improving Hearing and Communication

Hearing in the operated ear may be reduced for several weeks because of edema, accumulation of blood and tissue fluid in the middle ear, and dressings or packing. Measures are initiated to improve hearing and communication, such as reducing environmental noise, facing the patient when speaking, speaking clearly and distinctly without shouting, providing good lighting if the patient relies on speech reading, and using nonverbal clues (e.g., facial expression, pointing, gestures) and other forms of communication. Family members or significant others are instructed about effective ways to communicate with the patient. If the patient uses assistive hearing devices, one can be used in the unaffected ear.

Preventing Injury

Vertigo may occur after mastoid surgery if the semicircular canals or other areas of the inner ear are traumatized. Antiemetic or antivertiginous medications (e.g., antihistamines) can be prescribed if a balance disturbance or vertigo occurs. Safety measures such as assisted ambulation are implemented to prevent falls and injury. The patient is instructed to avoid heavy lifting, straining, exertion, and nose blowing for 2 to 3 weeks after surgery to prevent dislodging the tympanic membrane graft or ossicular prosthesis.

Facial nerve injury is a potential, although rare, complication of mastoid surgery. The patient is instructed to report immediately any evidence of facial nerve (cranial nerve VII) weakness, such as drooping of the mouth on the operated side, slurred speech, decreased sensation, and difficulty swallowing. A more frequent occurrence is a temporary disturbance in the chorda tympani nerve, which is a small branch of the facial nerve that runs through the middle ear. Patients experience a taste disturbance and dry mouth on the side of surgery for several months until the nerve regenerates.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care. Patients require education about medication therapy, such as analgesic and antivertiginous agents (e.g., antihistamines) prescribed for balance disturbance. Education includes information about the expected effects and potential side effects of the medication. Patients also need instruction about any activity restrictions. Possible complications such as infection, facial nerve weakness, or taste disturbances, including the signs and symptoms to report immediately, are included (see Chart 41-7).

Continuing and Transitional Care. Some patients, particularly older adult patients, who have had mastoid surgery may require the services of a home, community-based, or transitional care nurse for a few days after returning home. However, most people find that assistance from a family member or a friend is sufficient. The caregiver and patient are cautioned that the patient may experience some vertigo and will therefore require help with ambulation to avoid falling. Any symptoms of complications are to be reported promptly to the primary provider. The importance of scheduling and keeping follow-up appointments is also stressed.

Chart 41-7 PATIENT EDUCATION

Self-Care After Middle Ear or Mastoid Surgery

Postoperative instructions for patients who have had middle ear and mastoid surgery may vary among otolaryngologists. The nurse instructs the patient in the following general guidelines:

- Take antibiotics and other medications as prescribed.
- Avoid nose blowing for 2–3 weeks after surgery.
- Sneeze and cough with the mouth open for a few weeks after surgery.
- Avoid heavy lifting (>4.5 kg), straining, and bending over for a few weeks after surgery.
- Be aware that popping and crackling sensations in the operative ear are normal for approximately 3–5 weeks after surgery.
- Note that temporary hearing loss is normal in the operative ear due to fluid, blood, or packing in the ear.
- Report excessive or purulent ear drainage to the physician.
- Avoid getting water in the operative ear for 2 weeks after surgery. You may shampoo the hair 2–3 days postoperatively if the ear is protected from water by saturating a cotton ball with petrolatum jelly (or some other water-insoluble substance) and loosely placing it in the ear. If the postauricular suture line becomes wet, pat (not rub) the area and cover it with a thin layer of antibiotic ointment.

Evaluation

Expected patient outcomes may include:

1. Demonstrates reduced anxiety about surgical procedure
   a. Verbalizes and exhibits less stress, tension, and irritability
   b. Verbalizes acceptance of the results of surgery and adjustment to possible hearing impairment
2. Remains free of discomfort or pain
   a. Exhibits no facial grimacing, moaning, or crying, and reports absence of pain
   b. Uses analgesic agents appropriately
3. Demonstrates no signs or symptoms of infection
   a. Has normal vital signs, including temperature
   b. Demonstrates absence of purulent drainage from the external auditory canal
   c. Describes method for preventing water from contaminating packing
4. Exhibits signs that communication and hearing have stabilized or improved
   a. Describes surgical goal for hearing and judges whether the goal has been met
   b. Verbalizes that hearing has improved
5. Remains free of injury and trauma
   a. Reports absence of vertigo or balance disturbance
   b. Experiences no injury or fall
   c. Avoids activities that can cause dislodgement of graft or prosthesis
   d. Reports no taste disturbance, mouth dryness, or facial weakness

6. Verbalizes the reasons for and methods of care and treatment
   a. Discusses the discharge plan formulated with the nurse with regard to rest periods, medication, and activities permitted and restricted
   b. Lists symptoms that should be reported to the primary provider
   c. Keeps follow-up appointments

Otosclerosis

Otosclerosis involves the stapes and is thought to result from the formation of new, abnormal spongy bone, especially around the oval window, with resulting fixation of the stapes (Grossman & Porth, 2014). The efficient transmission of sound is prevented because the stapes cannot vibrate and carry the sound as conducted from the malleus and incus to the inner ear. Otosclerosis is more common in women, is a familial condition, and can progress to complete deafness (Eliopoulos, 2018); (Grossman & Porth, 2014).

Clinical Manifestations

Otosclerosis may involve one or both ears and manifests as a progressive conductive or mixed hearing loss. The patient may or may not complain of tinnitus. Otoscopic examination usually reveals a normal tympanic membrane. Bone conduction is better than air conduction on Rinne testing. The audiogram confirms conductive hearing loss or mixed loss, especially in the low frequencies.

Medical Management

The management of otosclerosis can be surgical or medical. Amplification with a hearing aid may help (Grossman & Porth, 2014).

Surgical Management

One of two surgical procedures may be performed: the stapedectomy or the stapedotomy. A stapedectomy involves removing the stapes superstructure and part of the footplate and inserting a tissue graft and a suitable prosthesis (see Fig. 41-6). In a stapedotomy, the surgeon drills a small hole into the stapes, instead of removing it, to hold a prosthesis. In both procedures, the prosthesis bridges the gap between the incus and the inner ear, providing better sound conduction. The majority of patients experience resolution of conductive hearing loss following stapes surgery. The use of sodium fluoride in the postoperative period increases the success rate and hearing ability postoperatively (Grossman & Porth, 2014). Balance disturbance or true vertigo may occur during the postoperative period for several days. Long-term balance disorders are rare.

Middle Ear Masses

Other than cholesteatoma, masses in the middle ear are rare. Glomus tympanicum is a tumor that arises from (in the temporal bone of the skull) and remains limited to the middle ear. On otoscopy, a red blemish on or behind the tympanic membrane is seen. Glomus jugulare tumors are rarely malignant; however,

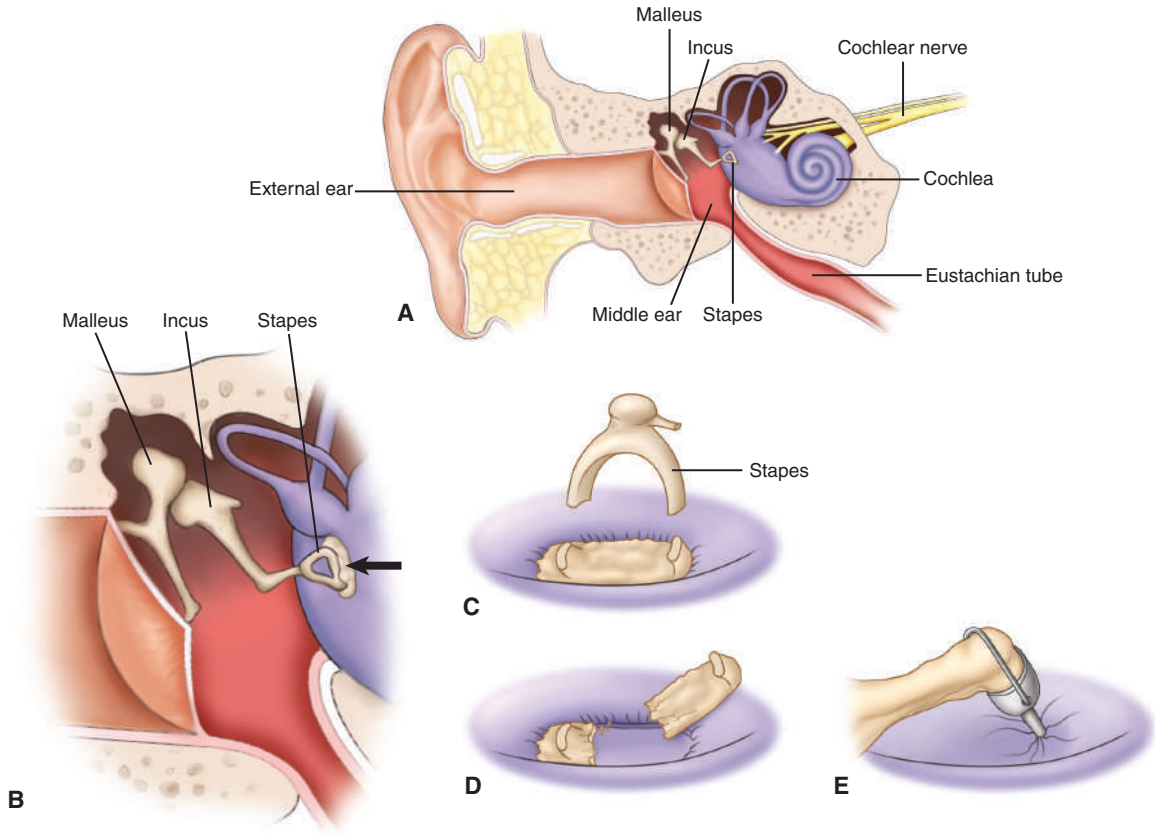


Figure 41-6 • Stapedectomy for otosclerosis. **A**. Normal anatomy. **B**. *Arrow* points to sclerotic process at the foot of the stapes. **C**. Stapes broken away surgically from its diseased base. The hole in the footplate provides an area where an instrument can grasp the plate. **D**. The footplate is removed from its base. Some otosclerotic tissue may remain, and tissue is placed over it. **E**. Robinson stainless steel prosthesis in position.

because of their location, treatment may be necessary to relieve symptoms. The treatment is surgical excision, except in patients who are poor surgical candidates, in whom radiation therapy is used.

A facial nerve neuroma is a tumor on cranial nerve VII. These types of tumors are usually not visible on otoscopic examination but are suspected when a patient presents with a facial nerve paresis. X-ray evaluation is used to identify the site of the tumor along the facial nerve. The treatment is surgical removal.

CONDITIONS OF THE INNER EAR

Disorders of balance are common (NIDCD, 2015a), and dizziness may increase the risk of falls. The term dizziness is used frequently by patients and health care providers to describe any altered sensation of orientation in space and is more commonly referred to as lightheadedness (Weber & Kelley, 2014). Vertigo is the misperception or illusion of motion of the person or the surroundings. Most patients with vertigo describe a spinning sensation or say they feel as though objects are moving around them. Ataxia is a failure of muscular coordination and may be present in patients with vestibular disease. Syncope, fainting, and loss of consciousness are not forms of vertigo and usually indicate disease in the cardiovascular system.

Nystagmus is an involuntary rhythmic movement of the eyes. Nystagmus occurs normally when a person watches a rapidly moving object (e.g., through the side window of a moving car or train). However, pathologically, it is an ocular disorder associated with vestibular dysfunction. Nystagmus can be horizontal, vertical, or rotary and can be caused by a disorder in the central or peripheral nervous system.

Motion Sickness

Motion sickness is a disturbance of equilibrium caused by constant motion. For example, it can occur aboard a ship, while riding on a merry-go-round or swing, or in a car (Brainard & Gresham, 2014).

Clinical Manifestations

The syndrome manifests itself in sweating, pallor, nausea, and vomiting caused by vestibular overstimulation. These manifestations may persist for several hours after the stimulation stops.

Management

Over-the-counter antihistamines such as dimenhydrinate (Dramamine) or meclizine (Antivert) may provide some relief of nausea and vomiting by blocking the conduction of the vestibular pathway of the inner ear. Anticholinergic medications, such as scopolamine patches (Transderm Scop), may also be effective because they antagonize the histamine response. These must be applied several hours before exposure to motion and replaced every 3 days (Brainard & Gresham, 2014). Side effects such as dry mouth and drowsiness may occur. Potentially hazardous activities such as driving a car or operating heavy machinery should be avoided if drowsiness occurs.

Ménière Disease

Ménière disease is an abnormality in inner ear fluid balance caused by a malabsorption in the endolymphatic sac or a blockage in the endolymphatic duct (NIDCD, 2015b). Endolymphatic hydrops (dilation of the endolymphatic space) develops, and either increased pressure in the system or rupture of the inner ear membrane occurs, producing symptoms of Ménière disease (Hansson & Brattmo, 2013).

Ménière disease affects 10 to 12 of 1000 people in the United States. It is estimated that there are 615,000 cases in the United States, with approximately 45,500 new cases diagnosed annually (NIDCD, 2015b). More than 500,000 people are affected by Meniere's disease in India (Business online india.com, 2016).

More common in adults, onset is generally seen when adults reach their 40s, with symptoms usually beginning between the ages of 20 and 60 years. Ménière disease appears to be equally common in men and women, and is usually bilateral (Grossman & Porth, 2014).

Clinical Manifestations

Ménière disease is characterized by a triad of symptoms: episodic vertigo, tinnitus (unwanted noises in the head or ear), and fluctuating sensorineural hearing loss. It may also include a feeling of pressure or fullness in the ear and incapacitating vertigo, often accompanied by nausea and vomiting (Hansson & Brattmo, 2013); (NIDCD, 2015b). These symptoms range in severity from a minor nuisance to extreme disability, especially if the attacks of vertigo are severe. At the onset of the disease, usually only one or two of the symptoms are manifested.

Some characterize the disease into two subsets: cochlear and vestibular. Cochlear Ménière disease is recognized as a fluctuating, progressive sensorineural hearing loss associated with tinnitus and aural pressure in the absence of vestibular symptoms or findings. Vestibular Ménière disease is characterized as the occurrence of episodic vertigo associated with aural pressure but no cochlear symptoms. Patients may experience either cochlear or vestibular disease symptoms; however, eventually all of these symptoms develop.

Assessment and Diagnostic Findings

Vertigo is usually the most troublesome complaint related to Ménière disease. A careful history is taken to determine the frequency, duration, severity, and character of the vertigo attacks. Vertigo may last minutes to hours, possibly accompanied by nausea or vomiting. Diaphoresis and a persistent feeling of imbalance or disequilibrium may awaken patients at night. Some patients report that these feelings last for days. However, they usually feel well between attacks. Hearing loss may fluctuate, with tinnitus and aural pressure waxing and waning with changes in hearing. These feelings may occur during or before attacks, or they may be constant.

Physical examination findings are usually normal, with the exception of those of cranial nerve VIII. Sounds from a tuning fork (Weber test) may lateralize to the ear opposite the hearing loss, the one affected with Ménière disease. An audiogram typically reveals a sensorineural hearing loss in the affected ear. This can be in the form of a "Pike's Peak" pattern, which looks like a hill or mountain. A sensorineural loss in the low frequencies occurs as the disease progresses. The electronystagmogram may be normal or may show reduced vestibular response.

Medical Management

Most patients with Ménière disease can be successfully treated with diet and medication. Many patients can control their

Chart 41-8 PATIENT EDUCATION

Dietary Guidelines for Patients with Ménière Disease

The nurse instructs the patient to:

- Limit foods high in salt or sugar. Be aware of foods with hidden salts and sugars.
- Eat meals and snacks at regular intervals to stay hydrated. Missing meals or snacks may alter the fluid level in the inner ear.
- Eat fresh fruits, vegetables, and whole grains. Limit the amount of canned, frozen, or processed foods with high sodium content.
- Drink plenty of fluids daily. Water, milk, and low-sugar fruit juices are recommended. Limit intake of coffee, tea, and soft drinks. Avoid caffeine because of its diuretic effect.
- Limit alcohol intake. Alcohol may change the volume and concentration of the inner ear fluid and may worsen symptoms.
- Avoid monosodium glutamate (MSG), which may increase symptoms.
- Pay attention to the intake of foods containing potassium (e.g., bananas, tomatoes, oranges) if taking a diuretic that causes potassium loss.
- Avoid aspirin and aspirin-containing medications. Aspirin may increase tinnitus and dizziness.

Adapted from National Institute on Deafness and Other Communication Disorders (NIDCD). (2015b). Ménière's disease. Retrieved on 6/12/2012 at: www.nidcd.nih.gov//health/balance/meniere.html

symptoms by adhering to a low-sodium (1000 to 1500 mg/day or less) diet. Chart 41-8 describes dietary guidelines that may be useful in Ménière disease. The amount of sodium is one of many factors that regulate the balance of fluid within the body. Sodium and fluid retention disrupts the delicate balance between endolymph and perilymph in the inner ear. Psychological evaluation and cognitive therapy may be indicated if a patient is anxious, uncertain, fearful, or depressed (NIDCD, 2015b).

Pharmacologic Therapy

Pharmacologic therapy for Ménière disease consists of antihistamines, such as meclizine, which shortens the attack (NIDCD, 2015b). Tranquilizers such as diazepam (Valium) may be used in acute instances to help control vertigo. Antiemetic agents such as promethazine (Phenergan) suppositories help control the nausea and vomiting and the vertigo because of their antihistamine effect. Diuretic therapy (e.g., hydrochlorothiazide [Dyazide], triamterene, spironolactone) may relieve symptoms by lowering the pressure in the endolymphatic system (Grossman & Porth, 2014). Intratympanic injection of gentamicin (Garamycin) is used to cause ablation of the vestibular hair cells; however, the risk of significant hearing loss is high (NIDCD, 2015b).

Surgical Management

Although most patients respond well to conservative therapy, some continue to have disabling attacks of vertigo. If these attacks reduce their quality of life, patients may elect to undergo surgery for relief. Surgical procedures include endolymphatic sac procedures and vestibular nerve section (NIDCD, 2015b). However, hearing loss, tinnitus, and aural fullness may continue, because the surgical treatment of Ménière disease is aimed at eliminating the attacks of vertigo.

Endolymphatic Sac Decompression

Endolymphatic sac decompression, or shunting, theoretically equalizes the pressure in the endolymphatic space. A shunt or drain is inserted in the endolymphatic sac through a postauricular incision. This procedure is favored by many otolaryngologists as a first-line surgical approach to treat the vertigo of Ménière disease because it is relatively simple and safe and can be performed on an outpatient basis.

Vestibular Nerve Sectioning

Vestibular nerve sectioning provides the greatest success rate (approximately 98%) in eliminating the attacks of vertigo. It can be performed by a translabyrinthine approach (i.e., through the hearing mechanism) or in a manner that can conserve hearing (i.e., suboccipital or middle cranial fossa), depending on the degree of hearing loss. Most patients with incapacitating Ménière disease have little or no effective hearing. Cutting the nerve prevents the brain from receiving input from the semicircular canals. This procedure may require a brief hospital stay. A plan of nursing care for the patient with vertigo is presented in Chart 41-9.

Benign Paroxysmal Positional Vertigo

Benign paroxysmal positional vertigo is a brief period of incapacitating vertigo that occurs when the position of the patient's head is changed with respect to gravity, typically by placing the head back with the affected ear turned down (Hansson & Brattmo, 2013); (NIDCD, 2015b). The onset is sudden and followed by a predisposition for positional vertigo, usually for hours to weeks but occasionally for months or years.

Benign paroxysmal positional vertigo is thought to be due to the disruption of debris within the semicircular canal. This debris is formed from small crystals of calcium carbonate from the inner ear structure (the utricle). This is frequently stimulated by head trauma, infection, or other events. In severe cases, vertigo may easily be induced by any head movement. The vertigo is usually accompanied by nausea and vomiting; however, hearing impairment does not generally occur.

Bed rest is recommended for patients with acute symptoms. Repositioning techniques can be used to treat vertigo. The canalith repositioning procedure, also known as the Epley maneuver, is commonly used (Hansson & Brattmo, 2013). This noninvasive procedure, which involves quick movements of the body, rearranges the debris in the canal. The procedure is performed by placing the patient in a sitting position, turning the head to a 45-degree angle on the affected side, and then quickly moving the patient to the supine position. The procedure is safe, inexpensive, and easy to perform.

Patients with acute vertigo may be treated with meclizine for 1 to 2 weeks. After this time, the meclizine is stopped and the patient is reassessed. Patients who continue to have severe positional vertigo may be premedicated with prochlorperazine (Compazine) 1 hour before the canalith repositioning procedure is performed.

Vestibular rehabilitation can be used in the management of vestibular disorders. This strategy promotes active use of the vestibular system through an interdisciplinary team approach, including medical and nursing care, stress management, biofeedback, vocational rehabilitation, and physical therapy. A physical therapist prescribes balance exercises that help the brain compensate for the impairment to the balance system.

Tinnitus

Tinnitus is a symptom of an underlying disorder of the ear that is associated with hearing loss. A decade long epidemiological study done among South Indians showed a prevalence of 29.3%

Chart 41-9 PLAN OF NURSING CARE

Care of the Patient with Vertigo

Nursing Diagnosis: Risk for injury related to altered mobility because of gait disturbance and vertigo
Goal: Remains free of any injuries associated with imbalance and/or falls

Nursing Interventions	Rationale	Expected Outcomes
1. Assess for vertigo, including history, onset, description of attacks, duration, frequency, and any associated ear symptoms (hearing loss, tinnitus, aural fullness).	1. Health history provides basis for interventions.	• Experiences no falls due to balance disturbance • Fear and anxiety are reduced • Performs exercises as prescribed • Takes prescribed medications appropriately • Assumes safe position when vertigo is present • Keeps head still when vertigo is present • Identifies a characteristic fullness or sense of pressure in the ear as occurring before an attack occurs • Reports measures that help reduce vertigo
2. Assess extent of disability in relation to activities of daily living.	2. Extent of disability indicates risk of falling.	
3. Instruct or reinforce vestibular/balance therapy as prescribed.	3. Exercises hasten labyrinthine compensation, which may decrease vertigo and gait disturbance.	
4. Administer, or educate about administration of, antivertiginous medications and/or vestibular sedation medication; instruct patient about side effects.	4. Alleviates acute symptoms of vertigo.	
5. Encourage patient to sit down and restrict activity when dizzy.	5. Decreases possibility of falling and injury.	
6. Place pillow on each side of head to restrict movement.	6. Movement aggravates vertigo.	
7. Assist patient in identifying aura that suggests an impending attack.	7. Recognition of aura may trigger the need to take medication before an attack occurs, thereby minimizing the severity of effects.	
8. Recommend that the patient keep eyes open and stare straight ahead when lying down and experiencing vertigo.	8. Sensation of vertigo decreases and motion decelerates if eyes are kept in a fixed position.	

Nursing Diagnosis: Risk-prone health behavior related to disability requiring change in lifestyle due to unpredictability of vertigo
Goal: Modifies lifestyle to decrease disability and exert maximum control and independence within limits posed by chronic vertigo

Nursing Interventions	Rationale	Expected Outcomes
1. Encourage patient to identify personal strengths and roles that can still be fulfilled.	1. Maximizes sense of regaining control and independence.	• Exerts maximum control of environment and independence within limits imposed by vertigo • Is informed about condition • Family and significant others are included in rehabilitation process • Uses strengths and potentials to engage in the most independent and constructive lifestyle
2. Provide information about vertigo and what to expect.	2. Reduces fear and anxiety.	
3. Include family and significant others in rehabilitative process.	3. Perceived beliefs of significant others are important for patient's adherence to medical regimen.	
4. Encourage patient to maintain sense of control by making decisions and assuming more responsibility for care.	4. Reinforces positive psychological and social outcomes.	

Nursing Diagnosis: Risk for deficient fluid volume related to increased fluid output, altered intake, and medications
Goal: Maintains normal fluid and electrolyte balance

Nursing Interventions	Rationale	Expected Outcomes
1. Assess, or have patient assess, intake and output (including emesis, liquid stools, urine, and diaphoresis). Monitor laboratory values of electrolytes.	1. Accurate records provide basis for fluid replacement.	• Laboratory values within normal limits • Alert and oriented; vital signs within normal limits, skin turgor normal; electrolytes normal • Mucous membranes are moist • Vomiting has stopped; usual oral intake is resumed
2. Assess indicators of dehydration, including blood pressure (orthostasis), pulse, skin turgor, mucous membranes, and level of consciousness.	2. Prompt recognition of dehydration allows early intervention.	
3. Encourage oral fluids as tolerated; discourage beverages containing caffeine (a vestibular stimulant).	3. Oral replacement is begun as soon as possible to replace losses.	

(Continued)

(Continued)

4. Administer, or educate about administration of, antiemetic medications as prescribed and needed. Educate patient about side effects.	4. Antiemetic medications reduce nausea and vomiting, reducing fluid losses and improving oral intake.

Nursing Diagnosis: Anxiety related to threat of, or change in, health status and disability effects of vertigo
Goal: Experiences less or no anxiety

Nursing Interventions	Rationale	Expected Outcomes
1. Assess level of anxiety. Help patient identify coping skills used successfully in the past.	1. Guides therapeutic interventions and participation in self-care. Past coping skills can relieve anxiety.	• Fear and anxiety about attacks of vertigo reduced or eliminated • Acquires knowledge and skills to deal with vertigo • Feels less tension, apprehension, and uncertainty • Uses stress management techniques when needed • Avoids upsetting encounters • Repeats instructions given and verbalizes understanding of treatments
2. Provide information about vertigo and its treatment.	2. Increased knowledge helps to decrease anxiety.	
3. Encourage patient to discuss anxieties and explore concerns about vertigo attacks.	3. Promotes awareness and understanding of relationship between anxiety level and behavior.	
4. Educate patient about stress management techniques or make appropriate referral.	4. Improved stress management can reduce the frequency and severity of some vertiginous attacks.	
5. Provide comfort measures, and avoid stress-producing activities.	5. Stressful situations may exacerbate symptoms of the condition.	
6. Instruct patient in aspects of treatment regimen.	6. Patient knowledge helps to decrease anxiety.	

Nursing Diagnosis: Risk for trauma related to impaired balance
Goal: Reduces the risk of trauma by adapting the home environment and by using assistive devices as necessary

Nursing Interventions	Rationale	Expected Outcomes
1. Assess for balance disturbance and/or vertigo by taking history and by examination for nystagmus, positive Romberg, and inability to perform tandem Romberg.	1. Peripheral vestibular disorders cause these signs and symptoms.	• Has adapted home environment or uses rehabilitative devices to reduce risk of falling • Ambulates with needed assistance • Visual and proprioceptive risks identified • Activity level increased • Home environment free of hazards
2. Assist with ambulation when indicated.	2. Abnormal gait can predispose patient to unsteadiness and falls.	
3. Assess for visual acuity and proprioceptive deficits.	3. Balance depends on visual, vestibular, and proprioceptive systems.	
4. Encourage increased activity level with or without use of assistive devices.	4. Increased activity may help retrain balance system.	
5. Help identify hazards in home environment.	5. Adaptation of home environment can reduce risk of falls during rehabilitative process.	

Nursing Diagnosis: Self-care deficit: feeding, bathing/hygiene, dressing/grooming, toileting, related to labyrinth dysfunction and episodes of vertigo
Goal: Able to care for self

Nursing Interventions	Rationale	Expected Outcomes
1. Administer, or educate about administration of, antiemetic and other prescribed medications to relieve nausea and vomiting associated with vertigo.	1. Antiemetic and sedative-type medications depress stimuli in the cerebellum.	• Carries out necessary functions during symptom-free periods and takes medications to relieve nausea, vomiting, or vertigo • Carries out daily activities • Accepts dietary plan and reports its effectiveness • Drinks fluids in sufficient amounts
2. Encourage patient to perform self-care when free of vertigo.	2. Spacing activities is important because episodes of vertigo vary in occurrence.	
3. Review diet with patient and caregivers. Offer fluids as necessary.	3. Sodium restriction helps improve an inner ear fluid imbalance in some patients, thereby decreasing vertigo. Fluids help prevent dehydration.	

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Nursing Diagnosis: Powerlessness related to illness regimen and being helpless in certain situations due to vertigo/balance disturbance
Goal: Experiences increased sense of control over life and activities despite vertigo/balance disturbance

Nursing Interventions	Rationale	Expected Outcomes
1. Assess patient's needs, values, attitudes, and readiness to initiate activities.	1. Involving patient in planning activities and care enhances potential for mastery.	• Does not restrict activities unnecessarily due to vertigo • Verbalizes positive feelings about own ability to achieve a sense of power and control • Identifies previous successful coping behaviors
2. Provide opportunities for patient to express feelings about self and illness.	2. Expressing feelings increases understanding of individual coping styles and defense mechanisms.	
3. Help patient identify previous coping behaviors that were successful.	3. Awareness increases understanding of stressors that trigger feeling of powerlessness. Awareness of past successes enhances self-confidence.	

Chart 41-10

Selected Ototoxic Substances

- **Aminoglycoside antibiotic agents**: amikacin, gentamicin, kanamycin, netilmicin, neomycin, streptomycin, tobramycin
- **Anti-inflammatory agents**: salicylates (aspirin), indomethacin
- **Antimalarial agents**: quinine, chloroquine
- **Chemicals**: alcohol, arsenic
- **Chemotherapeutic (antineoplastic) agents**: cisplatin, nitrogen mustard, carboplatin
- **Loop diuretic agents**: ethacrynic acid, furosemide, acetazolamide
- **Metals:** gold, mercury, lead
- **Other antibiotic agents:** erythromycin, minocycline, polymyxin B, vancomycin

Adapted from Mudd, P. (2016). Ototoxicity. Medscape. Retrieved on 9/12/2016 at: emedicine.medscape.com/article/857679-overview

tinnitus (Manchea, Madhavi, Meganandha. et al., 2016). The severity of tinnitus may range from mild to severe. Patients describe tinnitus as a roaring, buzzing, or hissing sound in one or both ears. Numerous factors may contribute to the development of tinnitus, including several ototoxic substances (see Chart 41-10). Underlying disorders that contribute to tinnitus may include cardiovascular disease, thyroid disease, hyperlipidemia, vitamin B_{12} deficiency, psychological disorders (e.g., depression, anxiety), fibromyalgia, otologic disorders (Ménière disease, acoustic neuroma), and neurologic disorders (head injury, multiple sclerosis).

A physical examination should be performed to determine the cause of tinnitus. Diagnostic testing determines if hearing loss is present. An audiograph speech discrimination test or a tympanogram may be used to help determine the cause. Some forms of tinnitus are irreversible; therefore, patients may need education and counseling about ways of adjusting to their treatment and dealing with tinnitus in the future.

Labyrinthitis

Labyrinthitis, an inflammation of the labyrinth of the inner ear, can be bacterial or viral in origin. Bacterial labyrinthitis is rare because of antibiotic therapy, but it sometimes occurs as a complication of otitis media. The infection can spread to the inner ear by penetrating the membranes of the oval or round windows. Viral labyrinthitis is a common diagnosis, but little is known about this disorder, which affects hearing and balance. The most common viral causes are mumps, rubella, rubeola, and influenza. Viral illnesses of the upper respiratory tract and herpetiform disorders of the facial and acoustic nerves (i.e., Ramsay Hunt syndrome) also cause labyrinthitis.

Clinical Manifestations

Labyrinthitis is characterized by a sudden onset of incapacitating vertigo, usually with nausea and vomiting, various degrees of hearing loss, and possibly tinnitus. The first episode is usually the worst; subsequent attacks, which usually occur over a period of several weeks to months, are less severe.

Management

Treatment of bacterial labyrinthitis includes IV antibiotic therapy, fluid replacement, and administration of an antihistamine (e.g., meclizine) and antiemetic medications. Treatment of viral labyrinthitis is based on the patient's symptoms.

Ototoxicity

A variety of medications may have adverse effects on the cochlea, vestibular apparatus, or cranial nerve VIII. All but a few, such as aspirin and quinine, cause irreversible hearing loss. Aspirin toxicity can produce bilateral tinnitus. IV medications, especially the aminoglycosides, are a common cause of ototoxicity, because they destroy the hair cells in the organ of Corti (see Chart 41-10). Antineoplastic agents also cause hair cell death in the cochlea, which can lead to hearing loss (Mudd, 2016). These medications can be found in the body several months later; side effects are dose dependent, with higher doses causing increased ototoxicity. Therefore, hearing loss may occur at any time, even several months after the last dose of the medication was given.

To prevent loss of hearing or balance, patients receiving potentially ototoxic medications should be counseled about their side effects (Lewis, McMillan, Hutter, et al., 2014) (see Chart 41-11). These medications should be used with caution in patients who are at high risk for complications, such as children, older adults, patients who are pregnant, patients with kidney or liver problems, and patients with current hearing disorders. Blood levels of the medications should be monitored, and patients receiving long-term IV antibiotics should be monitored with an audiogram twice each week during therapy.

Chart 41-11 NURSING RESEARCH PROFILE

Does Interferon Beta-1a Contribute to Hearing Loss in Patients with Multiple Sclerosis (MS)?

Lewis, M. S., McMillan, G. P., Hutter, M., et al. (2014). Does Interferon Beta-1a impact pure-tone hearing sensitivity among individuals with multiple sclerosis? Journal of Neuroscience Nursing, 46(6), 352–359.

Purpose

Previous studies reported that interferon medications, commonly used to treat multiple sclerosis (MS), might contribute to hearing loss. The purpose of this study was to assess participants with MS taking intramuscular interferon beta-1a and who have significantly poorer hearing compared to those not currently using any disease-modifying therapies.

Design

The design of this study was a secondary analysis of data that had been collected during two other large studies that evaluated hearing in those with MS. A linear mixed model was fit to the hearing thresholds of participants. The model included interferon use, MS subtype, gender, age, test frequency, MS duration in years and a disability score.

Findings

With all participants included (N = 52), there was insufficient evidence to infer that intramuscular interferon-beta 1a was not ototoxic compared to nonuse of a disease-modifying therapy at all frequencies at which participants had their hearing tested. After removing two participants who were outliers, the results indicated that there was support for no ototoxic effect of intramuscular interferon beta-1a at test frequencies from 250 to 6000 Hz. There was insufficient evidence, however, to rule out an ototoxic effect at 8000 Hz.

Nursing Implications

More research is needed to evaluate the ototoxic effects of interferon on hearing in patients with MS. Nurses should be aware of the potential for ototoxicity with interferon use and remind patients with MS to have their hearing evaluated on a regular basis throughout the course of treatment.

Acoustic Neuroma

Acoustic neuromas, also referred to as vestibular schwannomas, are slow-growing, benign tumors of cranial nerve VIII, usually arising from the Schwan cells of the vestibular portion of the nerve. Most acoustic tumors arise within the internal auditory canal and extend into the cerebellopontine angle to press on the brain stem, possibly destroying the vestibular nerve (Bader, Littlejohns, & Olson, 2016). Most acoustic neuromas are unilateral, except in von Recklinghausen disease (neurofibromatosis type 2), in which bilateral tumors occur (Grossman & Porth, 2014).

Acoustic neuromas develop in 1 of every 100,000 people per year. These neuromas account for 6% of all intracranial tumors and seem to occur with equal frequency in men and women at any age, although most occur during middle age (Hio, Kitahara, Uno, et al., 2013).

Assessment and Diagnostic Findings

The most common assessment findings of patients with acoustic neuromas are unilateral tinnitus and hearing loss with or without vertigo or balance disturbance. It is important to identify asymmetry in audiovestibular test results so that further workup can be performed to rule out an acoustic neuroma. Although conflicting data exist, the only known risk factor for acoustic neuroma is cell phone usage (Park, Vernick, & Ramakrishna, 2015). An MRI scan with a contrast agent (i.e., gadolinium or gadopentetate [Magnevist]) is the imaging study of choice. If the patient is claustrophobic or cannot undergo an MRI scan for other reasons, or if the scan is unavailable, a CT scan with contrast dye is performed. However, MRI is more sensitive than CT in delineating a small tumor.

Management

Conservative treatment is recommended for patients with tumors less than 1.5 cm and in those who are older. In addition, routine monitoring is recommended for these patients. For patients who are at low risk, surgical removal of the acoustic tumor is the treatment of choice because these tumors do not respond well to radiation or chemotherapy. Because treatment of acoustic tumors crosses several specialties, the interdisciplinary treatment approach involves a neurologist and a neurosurgeon. The objective of the surgery is to remove the tumor while preserving facial nerve function. Most acoustic tumors have damaged the cochlear portion of cranial nerve VIII, and hearing is impaired. In these patients, the surgery is performed using a translabyrinthine approach, and the hearing mechanism is destroyed. If hearing is still good before surgery, a suboccipital or middle cranial fossa approach to removing the tumor may be used. This procedure exposes the lateral third of the internal auditory canal and preserves hearing (Park et al., 2015).

Potential complications of surgery include facial nerve paralysis, cerebrospinal fluid leakage, meningitis, and cerebral edema. Death from acoustic neuroma surgery is rare (Park et al., 2015).

AURAL REHABILITATION

If hearing loss is permanent or cannot be treated by medical or surgical means or if the patient elects not to undergo surgery, aural rehabilitation may be beneficial. The purpose of aural rehabilitation is to maximize the communication skills of the person with hearing impairment. Aural rehabilitation includes auditory training, speech reading, speech training, and the use of hearing aids.

Auditory training emphasizes listening skills, so the person who is hearing impaired concentrates on the speaker. Speech reading (also known as lip reading) can help fill the gaps left by missed or misheard words. The goals of speech training are to conserve, develop, and prevent deterioration of current communication skills.

It is important to identify the type of hearing impairment a person has so that rehabilitative efforts can be directed at their particular need. Surgical correction may be all that is necessary to treat and improve a conductive hearing loss by eliminating the cause of the hearing loss. With advances in hearing aid technology, amplification for patients with sensorineural hearing loss is more helpful than ever.

Hearing Aids

A hearing aid is a device through which speech and environmental sounds are received by a microphone, converted to electrical signals, amplified, and reconverted to acoustic signals. Many aids available for sensorineural hearing loss depress the low frequencies, or tones, and enhance hearing for the high frequencies. A general guideline for assessing the patient's need for a hearing aid is a hearing loss exceeding 30 dB in the range of 500 to 2000 Hz in the better-hearing ear.

A hearing aid makes sounds louder, but it does not improve a patient's ability to discriminate words or understand speech. People who have low discrimination scores (i.e., 20%) on audiograms may derive little benefit from a hearing aid. Hearing aids amplify all sounds, including background noise, which may be particularly disturbing to the first-time wearer. Chart 41-12 identifies additional problems associated with hearing aid use. Computerized hearing aids are available to compensate for background noise or allow amplification at certain programmed frequencies rather than at all frequencies. Occasionally, depending on the type of hearing loss, binaural aids (i.e., one for each ear) may be indicated. Chart 41-13 provides tips for hearing aid care.

A hearing aid should be fitted according to the patient's needs (e.g., type of hearing loss, manual dexterity, and preferences), rather than the brand name, by a certified audiologist licensed to dispense hearing aids.

The evolution in technology has led to the availability of many smaller and more effective devices as well as different options and features of hearing aids (FDA, 2014) (see Chart 41-14). The majority of hearing aids sold today are behind-the-ear, in-the-ear, or in-the-canal types (see Table 41-4). One model is the Lyric, which is placed in the ear canal just 4 mm from the tympanic membrane. Its volume is controlled by a magnet, and when its batteries no longer function (1 to 4 months), a physician can remove it with the magnet and reinsert a new device. This device does not have many of the problems (e.g., feedback noise, overamplification of background noise) associated with other hearing aids, and it does not involve the expense and uncertainty of surgical procedures. However, it is not an option for a person whose ear canal is too narrow to accommodate it.

Chart 41-12

Hearing Aid Problems

Whistling Noise

- Loose ear mold
- Improperly made
- Improperly worn
- Worn out

Improper Aid Selection

- Too much power required in aid, with inadequate separation between microphone and receiver
- Open mold used inappropriately
- Inadequate amplification
- Dead batteries
- Cerumen in ear
- Cerumen or other material in mold
- Wires or tubing disconnected from aid
- Aid turned off or volume too low
- Improper mold
- Improper aid for degree of loss

Pain from Mold

- Improperly fitted mold
- Ear skin or cartilage infection
- Middle ear infection
- Ear tumor
- Unrelated conditions of the temporomandibular joint, throat, or larynx

Implanted Hearing Devices

There are several types of implanted hearing devices, ranging from implantable to semi-implantable devices (FDA, 2015).

Bone conduction devices, which transmit sound through the skull to the inner ear, are used in patients with a conductive

Chart 41-13 PATIENT EDUCATION

Tips for Hearing Aid Care

The nurse instructs the patient how to clean a hearing aid, check for malfunctions, and recognize complications:

Cleaning

- Keep in mind that the ear mold is the only part of the hearing aid that may be washed frequently.
- Wash the ear mold daily with soap and water.
- Allow the ear mold to dry completely before it is snapped into the receiver.
- Clean the cannula with a small pipe cleaner–like device.
- Note that properly caring for the ear device and keeping the ear canal clean and dry can prevent complications.

Checking for Malfunctions

- Be aware that inadequate amplification, a whistling noise, or pain from the mold can occur when a hearing aid is not functioning properly.
- Check for malfunctions:
  - Is the switch on properly?
  - Are the batteries charged and positioned correctly?
  - Is the ear mold clogged with cerumen? Ear wax can be easily removed with pin, pipe cleaner, or wax loop.
- Notify the hearing aid dealer if the hearing aid is still not working properly.
- Keep in mind that if the unit requires extended time for repair, the dealer may lend you a hearing aid until the repair can be accomplished.

Recognizing Complications

- Understand that common medical complications include external otitis media and pressure ulcers in the external auditory canal. Signs and symptoms of these infections include painful ear, especially when the external ear is touched; canal swelling; redness; difficulty hearing; pain radiating to the jaw area; and fever.
- Notify your health care provider for evaluation if any of these symptoms are present. You may need medication to treat infection, pain, or both.

Chart 41-14

Options and Features of Hearing Aids to Consider

- *T-Coil*: May improve hearing on the telephone by switching the settings from normal to telephone setting. This feature also assists in amplifying voices when the patient is in larger areas, such as theaters, auditoriums, and gymnasiums. Background noise may be toned down to adequately hear close conversation.
- *Directional Microphone*: Useful in environments with a lot of background noise and activity. The microphone may be directed toward the speaker and amplifies conversation while diminishing background noise.
- *Direct Audio Input*: Directly plugs into another device, such as a computer, television, or stereo, that is attached with an extension cord.
- *Feedback Suppression*: Suppresses whistling feedback noise.

Adapted from U.S. Food and Drug Administration. (2014). Medical devices: Types of hearing aids. Retrieved on 8/19/2016 at: www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/HomeHealthandConsumer/ConsumerProducts/HearingAids/ucm181470.htm

hearing loss if a hearing aid is contraindicated (e.g., those with chronic infection). The device is implanted postauricularly under the skin into the skull, and an external device—worn above the ear, not in the canal—transmits the sound through the skin. There are two types of implantable hearing aids. The bone-anchored hearing aid (BAHA) is implanted behind the ear in the mastoid area. The middle ear implantation (MEI) is implanted in the middle ear cavity. The BAHA is used for conductive or mixed hearing loss, whereas the MEI is used for sensorineural hearing loss (FDA, 2015).

The implantable middle ear hearing device (IMEHD) comes in two styles: piezoelectric and electromagnetic, which are partially or totally implanted. Patients must be 18 years or older, must be diagnosed with mild to severe sensorineural loss, and must have tried other conventional devices but achieved poor results to be considered candidates for this type of device. The implantable device has several advantages—for example, it may eliminate feedback, achieve good cosmetic results, and allow the patient to perform most preferred leisure activities (e.g., dancing, swimming). Disadvantages are that this device is expensive, necessitates surgery, requires periodic recharging of batteries, and has unpredictable power output (FDA, 2015).

The FDA has also approved the semi-implantable Vibrant Soundbridge (electromagnetic) and the total implantable Envoy Esteem (piezoelectric) devices. The Vibrant Soundbridge has an external device attached to the postauricular bone that transmits sound to the magnet in the middle ear that is attached to the long process of the incus. The magnet surrounds the long axis of the stapes, which in turn vibrates and sound is heard. The Envoy Esteem works similarly to the natural ear. The piezoelectric transducer is located at the head of the incus, which sends a signal that is amplified, filtered, and then converted back to a vibration signal. This vibration is delivered by the driver (piezoelectric transducer) and attached to the stapes capitulum; then, via the stapes bone, the inner ear receives the signal and is converted into a nerve impulse and translated into sound by the brain. The incus is removed prior to insertion of this device to prevent feedback from the sensor. It is estimated that sound is amplified up to 110 dB with this device (Shohet & Myers, 2011).

A cochlear implant is an auditory prosthesis used for people with profound sensorineural hearing loss bilaterally who do not benefit from conventional hearing aids. The cochlear implant directly stimulates the auditory nerve and has made it possible for people who are severely hearing impaired or who are deaf to hear sound (NIDCD, 2016). The hearing loss may be congenital or acquired. An implant does not restore normal hearing; rather, it helps the person detect medium to loud environmental sounds and conversation. The implant provides stimulation directly to the auditory nerve, bypassing the nonfunctioning hair cells of the inner ear. The microphone and signal processor, worn outside the body, transmit electrical stimuli to the implanted electrodes. The electrical signals stimulate the auditory nerve fibers and then the brain, where they are interpreted.

Worldwide, more than 324,200 people have received cochlear implants. In India, 25000 people have received cochlear implants (Kumar & Kameswaran, 2017). Studies report that older adult patients with cochlear implants experience improved understanding of speech and better cognition. Patients with cochlear implants were also noted to have more social interactions with others and improved quality of life. Research has reported that hearing improvement with a cochlear implant delays the occurrence as well as the progression of dementia (Mosnier, Bebear, Marx, et al., 2015). Candidates for a cochlear implant, who are usually at least 1 year of age, are selected after careful

TABLE 41-4 Hearing Aids

Site (Range of Hearing Loss)	Advantages	Disadvantages
Body, usually on the trunk (mild–profound)	Separation of receiver and microphone prevents acoustic feedback, allowing high amplification; generally used in a school setting	Bulky; requires long wire, which may be cosmetically displeasing; some loss of high-frequency response
Behind the ear (mild–profound)	Economical; powerful, with no long wires; easily used by children—adapts easily as the child grows, with only the ear mold needing replacement	Large size
In the ear (mild–moderately severe)	One-piece custom fit to contour of ear; no tubes or cords; miniature microphone located in the ear, which is a more natural placement; more cosmetically appealing due to easy concealment	Smaller size limits output; patients who have arthritis or cannot perform tasks requiring good manual dexterity may have difficulty with the small size of aid and/or battery; can require more repair than the behind-the-ear aid.
In the canal (mild–moderately severe)	Same as in-the-ear aids; less visible, so more cosmetically pleasing	Even smaller than in-the-ear aids; requires good manual dexterity and good vision

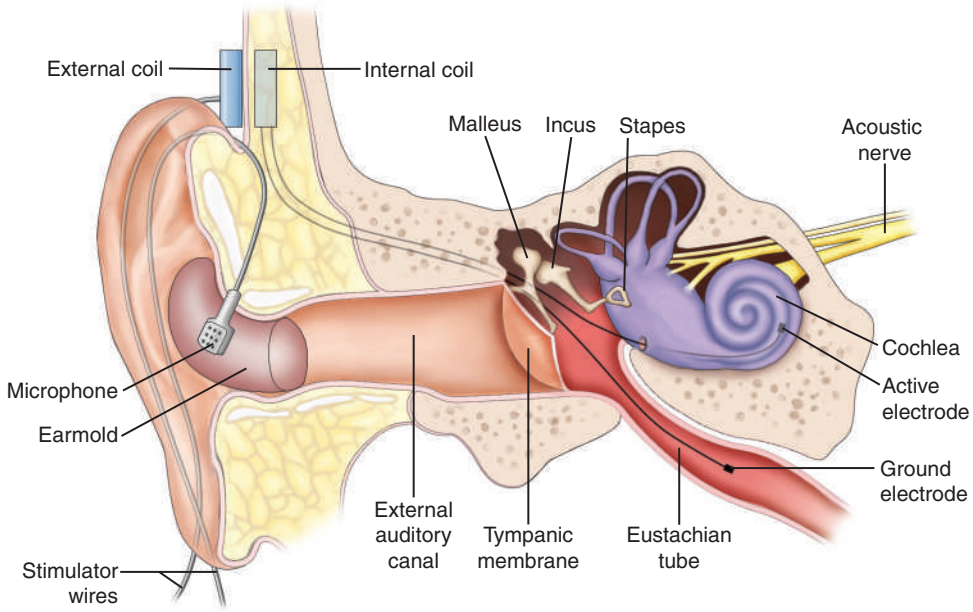


Figure 41-7 • The cochlear implant. The internal coil has a stranded electrode lead. The electrode is inserted through the round window into the scala tympani of the cochlea. The external coil (the transmitter) is held in alignment with the internal coil (the receiver) by a magnet. The microphone receives the sound. The stimulator wire receives the signal after it has been filtered, adjusted, and modified so that the sound is at a comfortable level for the patient. Sound is passed by the external transmitter to the inner coil receiver by magnetic conduction and is then carried by the electrode to the cochlea.

screening by otologic history, physical examination, audiologic testing, x-rays, and psychological testing. Criteria for choosing adults who may benefit from a cochlear implant include:

- Profound sensorineural hearing loss in both ears
- Inability to hear and recognize speech well with hearing aids
- No medical contraindication to a cochlear implant or general anesthesia
- Indications that being able to hear would enhance the patient's life

The surgery involves implanting a small receiver in the temporal bone through a postauricular incision and placing electrodes into the inner ear (see Fig. 41-7). The microphone and transmitter are worn on an external unit. The patient undergoes extensive cochlear rehabilitation with the multidisciplinary team, which includes an audiologist and speech pathologist. Several months may be needed to learn to interpret the sounds heard. Children and adults who lost their hearing before they learned to speak take much longer to acquire speech. There are wide variations of success with cochlear implants, and there is also controversy about their use, especially among the deaf community. Patients who have had a cochlear implant are cautioned that an MRI scan will inactivate the implant; MRI should be used only when there is no other diagnostic option.

CRITICAL THINKING EXERCISES

1. A 45-year-old patient who has been swimming frequently in the local pool has recently been diagnosed with otitis externa. Devise an evidence-based education plan for this patient, with consideration to the diagnosis, possible medical management and treatment options, and home care instructions. Identify evidence-based techniques that the patient should perform to prevent future infections.
2. A 91-year-old female has complained of hearing loss that has gradually worsened over the past few months. She has difficulty with hearing when carrying on a conversation with others, difficulty hearing the television, and having a telephone conversation. She has seen the primary provider today and has been diagnosed with cerumen impaction. Discuss how you will educate the patient about the diagnosis of cerumen impaction. What treatments will you plan to discuss and perform in the clinic? List treatments that the patient will need to perform at home. Should she expect to regain her previous hearing ability? What measures can she use to prevent cerumen impaction in the future?
3. You are providing home care for a 55-year-old patient with hypertension, diabetes, and a new diagnosis of vertigo. Identify the priorities, approach, and techniques you would use to provide nursing care to this patient. How would your priorities, approach, and techniques change if the patient was 85 years old and lived alone?

REFERENCES

*Asterisk indicates nursing research.

Books

Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Cash, J. C., & Glass, C. A. (2014). Family practice guidelines. New York: New York: Springer Publishing.

Eliopoulos, C. (2018). Gerontological nursing (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Fischbach, F., & Dunning, M. B. (2015). A manual of laboratory and diagnostic tests (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Grossman, S. C., & Porth, C. M. (2014). Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

American Academy of Otolaryngology- Head and Neck Surgery (2014). Position Statement: Posturography. Retrieved on 8/19/2016 at: www.entnet.org/content/position-statement-posturography.

Antonio, S. (2016). Genetic sensorineural hearing loss clinical presentation. Retrieved on 8/19/2016 at: emedicine.medscape.com/article/855875-clinical#b5.

Bhatti, S. L., Daly, L. T., Mejia, M., & Perlyn, C. (2021). Ear abnormalities. Pediatrics in Review, 42, 180. DOI: 10.1542/pir.2019-0167

Bhattacharyya, N., & Meyers, A. D. (2015). Auditory brainstem response auditometry. Retrieved on 8/19/2016 at: emedicine.medscape.com/article/836277-overview#a6.

Brainard, A., & Gresham, C. (2014). Prevention and treatment of motion sickness. American Family Physician, 90(1), 41–46.

Brock, D. W., Park, J. K., & Wendler, D. (2014). Making treatment decisions for oneself: Weighing the value. The Hastings Center Report, 46(3), 22–30.

Hansson, E. E., & Brattmo, M. (2013). Balance performance and self-perceived handicap among patients with Meniere's disease- A comparison with healthy controls. European Journal of Physiotherapy, 15(4), 221–224.

Hio, S., Kitahara, T., Uno, A., et al. (2013). Psychological condition in patients with an acoustic tumor. Acta Oto-Laryngologica, 133(1), 42–46.

Kumar, R. S., Kameshwaran,M. (2017). Cochlear implantation in the developing world: perspectives from the Indian subcontinent. ENT & Audiology News, 26 (4).

*Lewis, M. S., McMillan, G. P., Hutter, M., et al. (2014). Does Interferon Beta-1a impact pure-tone hearing sensitivity among individuals with multiple sclerosis? Journal of Neuroscience Nursing, 46(6), 342–359.

Manchea, K. S., Madhavi, J., Meganandha, K. A., & Jyothy, A. (2016). Association of tinnitus and hearing loss in ontological disorders: a decade long epidemiological study in South Indian population, Brazilian Journal of Otorhinolaryngology, 82(6), 643–649.

Mener, D. J., Betz, J., Genther, D. J., et al.(2013). Hearing loss and depression in older adults. Journal of the American Geriatrics Society, 61(9), 1627–1629.

Ménière's disease. Retrieved on 6/12/2012 at: www.nidcd.nih.gov//health/balance/meniere.html

Meniere's Disease in India-Audiologists hearing the call (2016). Retrieved on May 24th, 2018, at: http://www.businessonlineindia.com/menieres-disease-in-india-audiologists-hearing-the-call/.

Mosnier, I., Bebear, J. P., Marx, M., et al. (2015). Improvement of cognitive function after cochlear implantation in elderly patients. JAMA Otolaryngol Head Neck Surgery, 141(5), 442–450.

Mudd, P. (2016). Ototoxicity. Medscape. Retrieved on 9/12/2016 at: emedicine.medscape.com/article/857679-overview

National Institute on Deafness and Other Communication Disorders (NIDCD) (2010). WISE EARS. Update. Retrieved on 8/23/2016 at: www.nidcd.nih.gov/newsletter/2001/summer/wise-ears-update

National Institute on Deafness and Other Communication Disorders (NIDCD). (2014). Cochlear implants. Retrieved on 6/12/2016 at: www.nidcd.nih.gov/about/strategic-plan/2012-2016/2012-2016-nidcd-strategic-plan

National Institute on Deafness and Other Communication Disorders (NIDCD). (2015a). *NIDCD fact sheet*: Balance disorders. Retrieved on 6/12/2012 at: www.nidcd.nih.gov/staticresources/health/balance-disorders.

National Institute on Deafness and Other Communication Disorders (NIDCD). (2015b).

National Institute on Deafness and Other Communication Disorders (NIDCD). (2015c). Tinnitus. Retrieved on 6/12/2012 at: www.nidcd.nih.gov.

National Institute on Deafness and Other Communication Disorders (NIDCD) (2016). Strategic plan: FY 2012–2016. Retrieved on 9/12/2016 at: www.nidcd.nih.gov/staticresources/about/plans/strategic/FY2009–2011NIDCDStrategicPlan.pdf

Park, J. K., Vernick, D. M., & Ramakrishna, N. (2015). Vestibular schwannoma (acoustic neuroma). UpToDate. Retrieved on 8/25/2016 at: www.uptodate.com/contents/search?search = Vestibular+schwannoma+%28acoustic+neuroma% 29.+&x = 16&y = 8

Press information Bureau, Government of India (2016). Rights of Persons with Disabilities Bill - 2016 Passed by Parliament. Retrieved on May 16th, 2018 at http://pib.nic.in/newsite/PrintRelease.aspx?relid=155592

Shohet, J., & Myers, A. (2011). Implantable hearing devices. Medscape. Retrieved on 9/12/2016 at: emedicine.medscape.com/article/860444-overview

U.S. Department of Education. (2012). Department of education issues ADA amendment act dear colleague letter to provide guidance under amended legal standards. Retrieved on 6/12/2016 at: www.ed.gov/news/press-releases/department-education-issues-ada-amendments-act-dear-colleague-letter-provide-gui

U.S. Department of Health and Human Services (HHS). (2010). Healthy People 2020. Retrieved on 9/12/2016 at: www.healthypeople.gov/2020/topics-objectives/topic/
hearing-and-other-sensory-or-communication-disorders

U.S. Department of Health & Human Services (HHS). (2016). National Institute on Deafness and Other Communication Disorders: Statistics About Hearing. Retrieved on 8/23/2016 at: www.nidcd.nih.gov/health/statistics/quick-statistics-hearing.

U.S. Food and Drug Administration. (2014). Medical devices: Types of hearing aids. Retrieved on 8/19/2016 at: www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/HomeHealthandConsumer/ConsumerProducts/HearingAids/ucm181470.htm

U.S. Food and Drug Administration. (2015). Medical devices: Other products and devices to improve hearing. Retrieved on 8/19/2016 at: www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/HomeHealthandConsumer/ConsumerProducts/HearingAids/ucm181482.htm.

Varshney S. (2016). Deafness in India. Indian Journal of Otology, 22, 73-76. Retrieved on April 11th, 2018, at: http://www.indianjotol.org/temp/IndianJOtol22273-1532725_041427.pdf.

World Health Organization (WHO). (2021). Deafness and hearing loss. Retrieved on April 24th, 2022, at: https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss

Resources

Acoustic Neuroma Association (ANA), www.anausa.org

Alexander Graham Bell Association for the Deaf and Hard of Hearing, www.agbell.org

All India federation of deaf

American Academy of Audiology, www.audiology.org

American Academy of Facial Plastic and Reconstructive Surgery, www.aafprs.org

American Academy of Otolaryngology–Head and Neck Surgery, www.entnet.org

American Board of Facial Plastic and Reconstructive Surgery, www.abfprs.org

American Speech-Language-Hearing Association, www.asha.org

American Tinnitus Association (ATA), www.ata.org

Association of otolaryngologists of India (AOI India)www.aoiha.org

International Hearing Dog, Inc., www.ihdi.org

National Institute on Deafness and Other Communication Disorders (NIDCD), National Institutes of Health, www.nidcd.nih.gov

National association for deaf, http://nadindia.org/

Society of Otorhinolaryngology and Head-Neck Nurses, www.sohnnurse.com

Vestibular Disorders Association, www.vestibular.org

CHAPTER 42

Assessment and Management of Patients with Eye and Vision Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Identify the major structures and function of the eye.
2. Specify assessment and diagnostic findings used in the evaluation of ocular disorders.
3. Describe assessment and management strategies for patients with low vision and blindness.
4. List the pharmacologic actions and nursing management of common ophthalmic medications.
5. Recognize the clinical features, assessment and diagnostic findings, and medical or surgical management of glaucoma, cataracts, and other ocular disorders.
6. Explain the nursing management of patients with glaucoma, cataracts, and ocular trauma.
7. Discuss general discharge education for patients after ocular surgery.

GLOSSARY

anterior chamber: aqueous-containing space in the eye between the posterior (endothelial) cornea and the anterior iris and pupil
aqueous humor: transparent nutrient-containing fluid that fills the anterior and posterior chambers of the eye
astigmatism: refractive error due to an irregularity in the curvature of the cornea
binocular vision: normal ability of both eyes to focus on one object and fuse the two images into one
blindness: inability to see, defined as corrected visual acuity of 20/400 or less, or a visual field of no more than 20 degrees in the better eye
cataract: progressive opacity of the lens of the eye
chemosis: edema of the conjunctiva
diplopia: seeing one object as two; double vision
ectropion: turning out of the lower eyelid
emmetropia: normal refractive condition resulting in clear focus on retina; no optical defects
endophthalmitis: intraocular infection
entropion: turning in of the lower eyelid
enucleation: removal of the eyeball and part of the optic nerve
evisceration: removal of the intraocular contents through a corneal or scleral incision; the optic nerve, sclera, extraocular muscles, and sometimes the cornea are left intact
exenteration: surgical removal of the entire contents of the orbit, surrounding soft tissue, and most or all of the eyelids
glaucoma: group of conditions characterized by increased intraocular pressure
hyperemia: red eyes resulting from dilation of the vasculature of the conjunctiva
hyperopia: farsightedness; light rays focus behind the retina
hyphema: blood in the anterior chamber
hypopyon: collection of inflammatory cells in the anterior chamber of the eye
injection: congestion of blood vessels
keratoconus: cone-shaped deformity of the cornea
myopia: nearsightedness; light rays focus in front of the retina
neovascularization: growth of abnormal new blood vessels
nystagmus: involuntary oscillation of the eyeball
papilledema: swelling of the optic disc usually due to increased intracranial pressure
photophobia: ocular pain on exposure to light
presbyopia: the loss of accommodative power in the lens due to age
proptosis or exophthalmos: abnormal protrusion of the eyeball
ptosis: drooping eyelid
refraction: determination of the refractive errors of the eye for the purpose of vision correction
scotomas: blind or partially blind areas in the visual field
sympathetic ophthalmia: an inflammatory condition created in the fellow eye by the affected eye
trachoma: an infectious disease caused by the bacterium *Chlamydia trachomatis*—the leading cause of preventable blindness in the world
trichiasis: turning in of the eyelashes
vitreous humor: transparent, colorless gelatinous material that fills the vitreous chamber behind the lens

Note: Common abbreviations related to vision and eye health are OD (oculus dexter, right eye), OS (oculus sinister, left eye), and OU (oculus uterque, both eyes).

Introduction

The eye is a sensitive, highly specialized sense organ subject to various disorders, many of which can lead to impaired vision. Impaired vision may affect individuals in many ways, including their independence in self-care, sense of self-esteem, safety, and overall quality of life. Many of the leading causes of visual impairment are associated with aging (e.g., cataracts, glaucoma, and macular degeneration). Younger people are also at risk for eye disorders, particularly traumatic injuries.

Although most people with eye disorders are treated in an ambulatory care setting, various eye disorders are seen in many settings. In addition to understanding the prevention, treatment, and consequences of eye disorders, nurses in all settings assess visual acuity in patients at risk (e.g., older adults, those with hypertension, diabetes or acquired immune deficiency syndrome [AIDS]), refer patients to eye care specialists as appropriate, implement measures to prevent further visual loss, and help patients adapt to impaired vision.

ASSESSMENT OF THE EYE

Anatomic and Physiologic Overview

Unlike most organs of the body, the eye is available for external examination, and its anatomy is more easily assessed than other body parts (see Fig. 42-1). The eyeball, or globe, sits in the bony protective orbit (Hogan, 2014). Lined with muscle and connective and adipose tissues, the orbit is shaped like a four-sided pyramid, surrounded on three sides by the sinuses: ethmoid (medially), frontal (superiorly), and maxillary (inferiorly). The optic nerve and the ophthalmic artery enter the orbit at its apex through the optic foramen. The eyeball is moved through all fields of gaze by the extraocular muscles. The four rectus muscles and two oblique muscles (see Fig. 42-2) are innervated by cranial nerves (CNs) III, IV, and VI. Normally, the movements of the two eyes are coordinated and the brain perceives a single image.

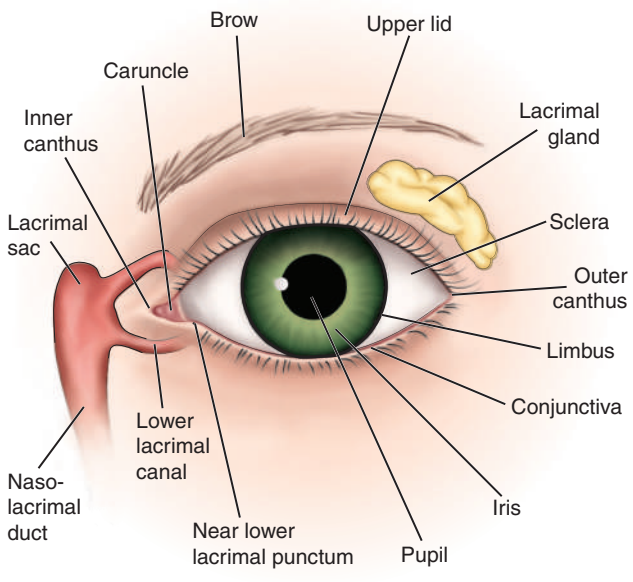


Figure 42-1 • External structures of the eye and position of the lacrimal structures.

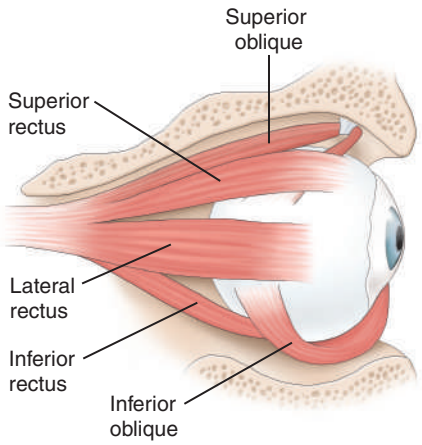


Figure 42-2 • The extraocular muscles responsible for eye movement. The medial rectus muscle (not shown) is responsible for opposing the movement of the lateral rectus muscle.

The eyelids are composed of thin, elastic skin that covers striated and smooth muscles and protect the anterior portion of the eye. The eyelids contain multiple glands (sebaceous, sweat, and lacrimal). The upper lid normally covers the uppermost portion of the iris and is innervated by the oculomotor nerve (CN III). The lid margins contain meibomian glands, the inferior and superior puncta, and the eyelashes. The triangular spaces formed by the junction of the eyelids are known as the inner or medial canthus and the outer or lateral canthus. With every blink, the eyelids wash the cornea and conjunctiva with tears.

Tears are vital to eye health. Formed by the lacrimal gland and the accessory lacrimal glands, tears are secreted in response to reflex or emotional stimuli. A healthy tear is composed of three layers: lipoid, aqueous, and mucoid. These layers nourish the cornea and create a smooth optical surface of the cornea and conjunctival epithelium. If there is a defect in the composition of any of these layers, the integrity of the cornea may be compromised.

The conjunctiva, a thin transparent mucous membrane, provides a barrier to the external environment extending under the eyelids (palpebral conjunctiva) and over the sclera (bulbar conjunctiva). The junction of the two portions is known as the fornix. The conjunctiva meets the cornea at the limbus on the outermost edge of the iris.

The eyeball is composed of the following three layers:

- The outer dense fibrous layer, including the sclera and transparent cornea
- The middle vascular layer, containing the iris, ciliary body, and choroid
- The inner neural layer, including the retina, optic nerve, and visual pathway

The eyeball is divided anatomically into two segments. The anterior segment is between the anterior cornea and posterior iris, including the anterior and posterior chamber. The posterior segment is between the posterior lens and the retina, including the vitreous chamber. The eyeball also has three fluid-containing chambers. The aqueous-filled anterior chamber lies between the posterior cornea and the anterior iris and pupil. The posterior chamber is a small aqueous containing space between the posterior iris and pupil and anterior lens. The vitreous chamber, containing clear gelatinous vitreous fluid, is the largest chamber in the ocular fundus between the lens and retina (see Fig. 42-3).

The aqueous humor (transparent nutrient-containing fluid that fills the anterior and posterior chambers of the eye) is produced in the posterior chamber by the ciliary body (Grossman & Porth, 2014). It flows through the pupil into the anterior chamber and drains through the trabecular meshwork into the canal of Schlemm. Production of aqueous humor is related to the intraocular pressure (IOP). Normal IOP is less than 21 mm Hg (Eldaly, Bunce, El Sheikha, et al., 2014). Vitreous humor, which is composed mostly of water and encapsulated by a hyaloid membrane, helps maintain the shape of the eye. The vitreous is attached to the retina by scattered collagenous filaments. The vitreous shrinks and shifts with age. Through this degenerative process, the gel-like characteristics liquefy, causing stringy debris known as floaters.

The sclera is the white avascular dense fibrous structure that helps maintain the shape of the eyeball and protects the intraocular contents. Scleral thinning and changes of the scleral collagen fibers can cause the underlying uveal pigment

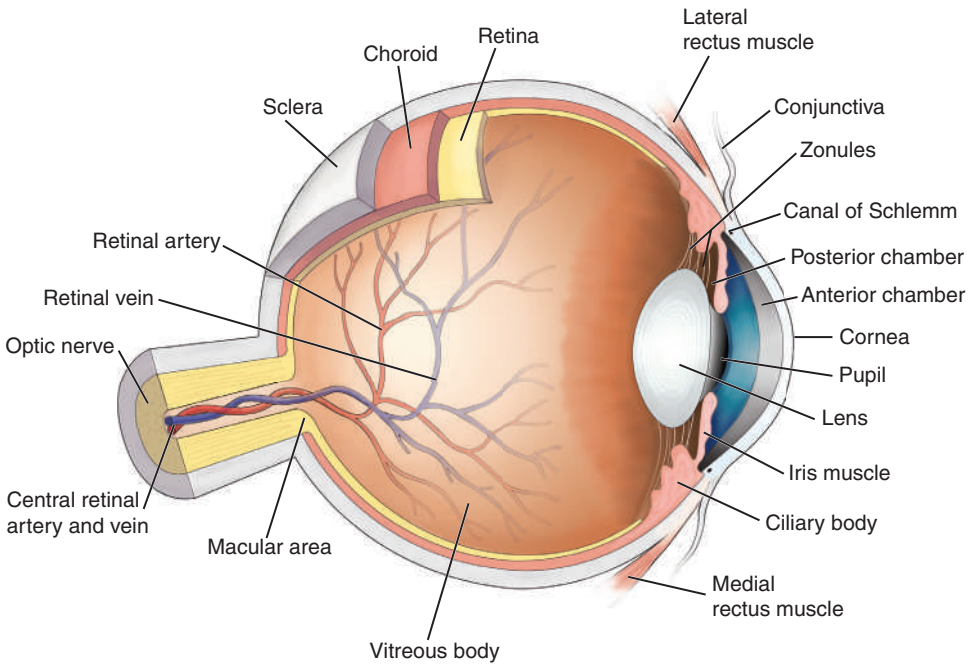


Figure 42-3 • Three-dimensional cross-section of the eye.

to be seen, resulting in a blue or gray sclera. The episclera is a vascularized loose elastic tissue that overlies the sclera supplying nutritional support and reacting to inflammation.

The cornea, a vulnerable transparent avascular domelike structure, forms the most anterior portion of the eyeball and is the main refracting surface of the eye. It is composed of five layers: the epithelium, Bowman membrane, stroma, Descemet membrane, and endothelium. It contains high concentrations of nerve fibers and is extremely sensitive to pain. The epithelium, the outermost protective layer, absorbs oxygen and nutrients from the tear film nourishing the cornea. The epithelial cells readily regenerate, unlike the innermost endothelial cells, which do not regenerate and result in corneal edema when injured.

The uveal tract is the vascular middle layer of the eye consisting of the iris, ciliary body, and the choroid.

The iris surrounding the pupil is a highly vascularized pigmented collection of fibers that give the eye color. The dilator and sphincter muscles of the iris control pupil size. The dilator muscles are controlled by the sympathetic nervous system. The sphincter muscles are controlled by the parasympathetic nervous system.

The ciliary body consists of ciliary processes, ciliary muscles, and zonular fibers (ligaments) that work together to form aqueous fluid and control focusing through the zonular fibers that suspend the crystalline lens.

The choroid lies between the retina and the sclera, supplying blood and oxygen to the outer retina. Pigmented cells containing melanocytes in the choroid assist to absorb scattered light.

Directly behind the pupil and iris lies the lens, an avascular and almost completely transparent biconvex structure held in position by zonular fibers in the ciliary body. The lens enables focusing for near and distance vision through accommodation, the process by which the lens of the eye adjusts the focal length to focus a clear image on the retina. With aging and certain conditions (e.g., diabetes or trauma), the lens loses its transparency and ability to focus due to formation of a cataract (see later discussion).

The retina—the innermost surface of the fundus composed of neural tissue—is an extension of the optic nerve. Viewed through the pupil, the landmarks of the retina are the optic disc, the retinal vessels, and the macula. The point of entrance of the optic nerve into the retina is the optic disc. The optic disc is pink, either oval or circular in shape, and has sharp margins. In the disc, a physiologic depression or cup is present centrally, with the retinal blood vessels emerging from it. The retinal tissues arise from the optic disc and line the inner surface of the vitreous chamber. The retinal vessels enter the eye through the optic disc, branching out through the retina and forming superior and inferior branches. The macula is the area of the retina responsible for central vision. The rest of the retina is responsible for peripheral vision. In the center of the macula is the most sensitive area—the fovea—which is avascular and surrounded by the superior and inferior vascular arcades. Two important layers of the retina are the retinal pigment epithelium (RPE) and the sensory retina. A single layer of cells constitutes the RPE. These cells have numerous functions, including the absorption of light. The sensory retina contains the photoreceptor cells: rods and cones. The rods are responsible for night or low light vision. The cones are retinal photoreceptor cells essential for visual acuity, color discrimination, and fine detail. Cones are distributed throughout the retina, with their greatest concentration in the fovea. Rods are absent in the fovea.

Visual acuity depends on a healthy functioning eye and an intact visual pathway. This pathway is made up of the retina, optic nerve, optic chiasm, optic tracks, lateral geniculate bodies, optic radiations, and the visual cortex area of the brain. The visual pathway is part of the central nervous system (see Fig. 42-4).

The optic nerve (CN II) transmits impulses from the retina to the occipital lobe of the brain. The optic nerve head, or optic disc, is the physiologic blind spot in each eye. The optic nerve leaves the eye and then meets the optic nerve from the other eye at the optic chiasm. The chiasm is the anatomic point at which the nasal fibers from the nasal retina of each eye cross to the opposite side of the brain. The nerve fibers from the temporal

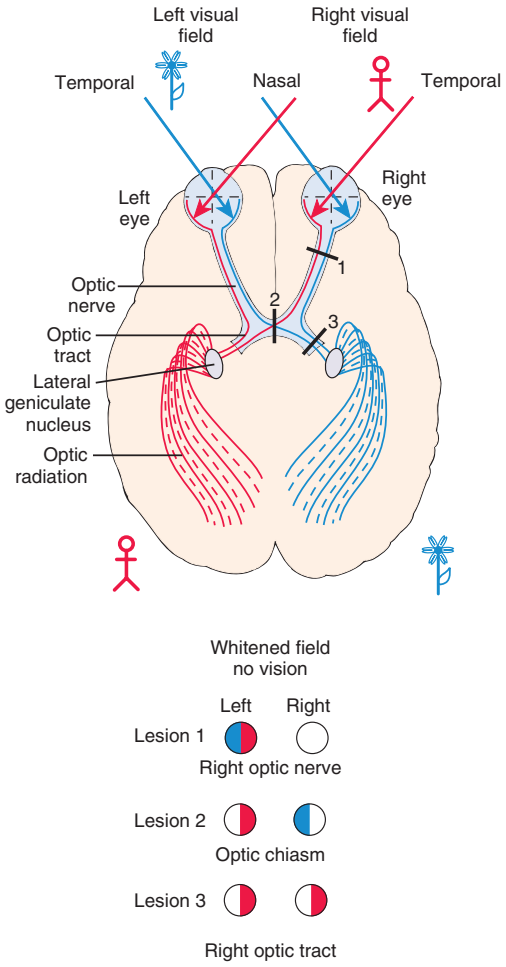


Figure 42-4 • Diagram of optic pathways. The *red* lines indicate the right visual field and the *blue* lines the left visual field. Note the crossing of the fibers from the medial half of each retina at the optic chiasm. Lesion 1 (right optic nerve) produces unilateral blindness. Lesion 2 (optic chiasm) may involve only those fibers that originate in the nasal half of each retina and cross to the opposite side in each field (bitemporal hemianopia). Lesion 3 (right optic tract) interrupts fibers (and vision) originating on the same side of both eyes (homonymous) with loss of vision from half of each field (hemianopia). Reprinted with permission from Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

retina of each eye remain uncrossed. Fibers from the right half of each eye, which would be the left visual field, carry impulses to the right occipital lobe. Fibers from the left half of each eye, or the right visual field, carry impulses to the left occipital lobe. Beyond the chiasm, these fibers are known as the optic tract. The optic tract continues on to the lateral geniculate body. The lateral geniculate body is connected by the optic radiations to the cortex of the occipital lobe of the brain.

Assessment

Ocular History

The nurse, through careful questioning, elicits the necessary information that can assist in diagnosis of an ophthalmic condition. Pertinent questions to ask when taking an ocular history are presented in Chart 42-1. Genetics plays a role in many eye and vision disorders (Lee & Garg, 2015) (see Chart 42-2).

Visual Acuity

Following the health history, the patient's visual acuity is assessed. This is an essential part of the eye examination and a measure against which all therapeutic outcomes are based.

Visual acuity is tested for both near (14 inches away) and distance (20 feet away) vision and is performed on each eye separately with a standardized Snellen chart for distance and a Rosenbaum pocket screener for near vision. A tumbling "E," "illiterate E," number, or regional language alphabet chart or picture chart is used if the person is illiterate (Weber & Kelley, 2014).

The Snellen chart is composed of a series of progressively smaller rows of letters; the person is asked to read the lowest line possible. The fraction 20/20 is considered the standard of normal vision. Most people can see the letters on the line designated as 20/20. The patient should be encouraged to read every letter possible.

Visual acuity is then recorded. The following would be an example of visual acuity documentation: A patient reads all five letters from the 20/20 line on the Snellen chart with the right eye (OD) and three of the five letters on the 20/30 line with the left eye (OS); the visual acuity is documented as OD: 20/20 and OS: 20/30 (Weber & Kelley, 2014).

If the patient cannot see the big "E" at the top of the Snellen chart, the examiner should determine next if the patient can count fingers ("CF" in documentation). Initially, the examiner

Chart 42-1 ASSESSMENT

Taking a History of Patients with Eye and Vision Disorders

- What does the patient perceive to be the problem?
- Is visual acuity diminished?
- Does the patient experience blurred, double, or distorted vision?
- Is there pain? Is it sharp or dull? Is it worse when blinking?
- Is the discomfort an itching sensation or more of a foreign-body sensation?
- Are both eyes affected?
- Is there a history of discharge? If so, inquire about color, consistency, and odor.
- Describe the onset of the problem (sudden, gradual). Is it worsening?
- What is the duration of the problem?
- Is this a recurrence of a previous condition?
- How has the patient self-treated?
- What makes the symptoms improve or worsen?
- Has the condition affected performance of activities of daily living?
- Are there any systemic diseases? What medications are used in their treatment?
- What other eye conditions does the patient have?
- Is there a history of eye surgery?
- Have other family members had the same symptoms or condition?

Adapted from Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Chart 42-2 GENETICS IN NURSING PRACTICE

Eye and Vision Disorders

Several eye and vision disorders are associated with genetic abnormalities. Some examples include:

Autosomal dominant:
- Aniridia
- Vitelliform macular dystrophy

Autosomal recessive:
- Achromatopsia
- Homocystinuria
- Leber congenital amaurosis

X linked:
- Choroideremia
- Color blindness

Mitochondrial inheritance:
- Leber hereditary optic neuropathy

Multiple inheritance patterns identified:
- Glaucoma
- Macular degeneration
- Retinitis pigmentosa

Other genetic illness that will impact vision:
- Albinism
- Isolated familial congenital cataracts
- Marfan syndrome
- Stickler syndrome
- Tay–Sachs disease
- Usher syndrome

Nursing Assessments

Family History Assessment Specific to Vision

- Assess history of family members in the past three generations with glaucoma, cataracts, night blindness (retinitis pigmentosa), color blindness, or other vision impairment.
- Inquire about the age of onset of symptoms (the onset of Leber congenital amaurosis is in childhood, whereas the onset of Leber hereditary optic neuropathy is in young adulthood).
- Inquire about family members with other disorders that may include visual impairment, such as cutaneous, metabolic, or connective tissue disorders and hearing loss.

Patient Assessment Specific to Vision

- Assess for other systemic and/or clinical features such as cutaneous or skeletal conditions, or hearing loss.
- Look for color and clarity of iris.
- Assess for presence of strabismus (cross-eyes), amblyopia (lazy eye), nystagmus, astigmatism, and near- or far-sightedness.
- Assess for changes in visual acuity.
- Assess field of vision.
- Inquire about photophobia, night blindness, or double vision.

Genetics Resources

National Opthalmic Disease Genotyping Network, https://eyegene.nih.gov

stands 5 feet from the person, holds up a random number of fingers, and then asks the patient to count the number of fingers seen. If the patient is unable to count fingers at 5 feet, the examiner keeps moving a foot closer until either 1 foot away or the person can correctly count fingers. If the patient correctly counts the number of fingers at 3 feet, for example, the examiner would record vision as CF/3 ft.

If the patient cannot count fingers, the examiner raises one hand up and down or moves it side to side and asks in which direction the hand is moving. This level of vision is known as hand motion. A patient who can perceive only light is described as having light perception. The vision of a patient who cannot perceive light is described as no light perception.

External Eye Examination

The nurse uses a systematic approach to perform an external eye examination by first assessing for symmetry and placement of eyelids, pupils, and muscles. CNs III, IV, and VI control movement and pupil size. The eyelids should rest just above and below the corneal limbus without exposure of the sclera. The nurse observes for ptosis (drooping of the eyelid), ectropion (turning out of the lower eyelid), or entropion (turning in of the lower eyelid). Entropion may involve trichiasis (turning in of the eyelashes). Eyelids and lashes should be free of drainage or scaling.

The room should be darkened so that the pupils can be examined. The pupillary response is checked with a penlight to determine if the pupils are equally reactive and regular. A normal pupil is black. An irregular pupil may result from trauma, previous surgery, or a disease process.

The patient's eyes are observed in primary or direct gaze, and any head tilt is noted. A head tilt may indicate cranial nerve palsy. The patient is asked to stare at a target; each eye is covered and uncovered quickly while the examiner looks for any shift in gaze. The examiner observes for nystagmus (involuntary oscillating movement of the eyeball). The extraocular movements of the eyes are tested by having the patient follow the examiner's finger, pencil, or a hand light through the six cardinal directions of gaze (i.e., up, down, right, left, and both diagonals). This is especially important when screening patients for ocular trauma or for neurologic disorders such as stroke or myasthenia gravis (Hickey, 2014).

Diagnostic Evaluation

A wide range of diagnostic studies may be performed in patients with eye disorders. The nurse should educate the patient about the purpose, what to expect, and any possible side effects related to these examinations prior to testing. The nurse should be aware of contraindications, potential complications, and trends in results. Trends provide information about disease progression as well as the patient's response to therapy.

Direct Ophthalmoscopy

A direct ophthalmoscope is a handheld instrument with various plus and minus lenses (Weber & Kelley, 2014). The lenses can be rotated into place, enabling the examiner to bring the cornea, lens, and retina into focus sequentially. The examiner holds the ophthalmoscope in the right hand and uses the right eye to examine the patient's right eye. The examiner switches to the left hand and left eye when examining the patient's left eye. During this examination, the room should be darkened, and the patient's eye should be on the same level as the examiner's eye. The patient and the examiner should be comfortable, and both should breathe normally. The patient is given a target to gaze at and is encouraged to keep both eyes open and steady.

When the fundus is examined, the vasculature comes into focus first. The veins are larger in diameter than the arteries. The examiner focuses on a large vessel and then follows it toward the midline of the body, which leads to the optic nerve. The central depression in the disc is known as the cup. The normal cup is about one third the size of the diameter of the disc. The size of the physiologic optic cup should be estimated and the disc margins described as sharp or blurred. A silvery or coppery appearance, which indicates arteriolosclerosis, should be noted. The periphery of the retina is examined by having the patient shift their gaze. The last area of the fundus to be examined is the macula, because this area is the most sensitive to light. The retina of a young person often has a glistening effect, sometimes referred to as a cellophane reflex.

The healthy fundus should be free of any lesions. The examiner looks for intraretinal hemorrhages, which may appear as red smudges, and, if the patient has hypertension, they may be somewhat flame shaped. Lipid with a yellowish appearance may be present in the retina of patients with hypercholesterolemia or diabetes. Soft exudates that have a fuzzy, white appearance (cotton-wool spots) should be noted. The examiner looks for microaneurysms, which look like little red dots, and nevi. Drusen (small, hyaline, globular deposits), commonly found in macular degeneration, appear as yellowish areas with indistinct edges. Small drusen have a more distinct edge. The examiner should sketch the fundus and document any abnormalities.

Indirect Ophthalmoscopy

The indirect ophthalmoscope is an instrument commonly used by the ophthalmologist to see larger areas of the retina, although in an unmagnified state. It produces a bright and intense light. The light source is affixed with a pair of binocular lenses mounted on the examiner's head. The ophthalmoscope is used with a handheld, 20-diopter lens.

Slit-Lamp Examination

The slit lamp is a binocular microscope mounted on a table. This instrument enables the user to examine the eye with magnification of 10 to 40 times the real image. The illumination can be varied from a broad to a narrow beam of light for different parts of the eye. For example, by varying the width and intensity of the light, the anterior chamber can be examined for signs of inflammation. Cataracts may be evaluated by changing the angle of the light. When a handheld contact lens, such as a three-mirror lens, is used with the slit lamp, the angle of the anterior chamber may be examined, as may the ocular fundus.

Tonometry

Tonometry is an essential part of a diagnostic evaluation; it measures IOP to screen for and manage glaucoma. The device used for measuring IOP is an accurately calibrated applanation tonometer, which measures the pressure needed to flatten the cornea. Because the probe or prism touches the highly sensitive cornea, a topical anesthetic is given prior to measurement (Hogan, 2014).

Nursing Interventions

Providing patient education prior to tonometry helps avoid possible errors in IOP measurement. Patients are cautioned to avoid squeezing the eyelids, holding their breath, or performing a Valsalva maneuver, because these may result in abnormally increased IOP.

Color Vision Testing

The ability to differentiate colors has a dramatic effect on the activities of daily living (ADLs). For example, the inability to differentiate between red and green can compromise traffic safety. Some careers (e.g., commercial artist, [color] photographer, airline pilot, and electrician) may be closed to people with significant color deficiencies. The photoreceptor cells responsible for color vision are the cones, and the greatest area of color sensitivity is in the macula—the area of densest cone concentration.

A screening test, such as the polychromatic plates discussed in the next paragraph, can be used to establish whether a person's color vision is within normal range. Color vision deficits can be inherited. For example, red–green color deficiencies are inherited in an X-linked manner, affecting approximately 8% of men and 0.5% of women (Colour Blind Awareness, 2016). Acquired color vision losses may be caused by medications (e.g., digitalis) or pathology (e.g., cataracts). A simple test, such as asking a patient if the red top on a bottle of eye drops appears redder to one eye than the other, can be an effective tool. A difference in the perception of the intensity of the color red between the two eyes can be a symptom of a neurologic problem and may provide information about the location of the lesion.

Because alteration in color vision sometimes indicates conditions of the optic nerve, color vision testing is often performed in a neuro-ophthalmologic workup. The most common color vision test is performed using Ishihara polychromatic plates. These plates are bound together in a booklet. On each plate of this booklet are dots of primary colors that are integrated into a background of secondary colors. The dots are arranged in simple patterns, such as numbers or geometric shapes. Patients with diminished color vision may be unable to identify the hidden shapes. Patients with central vision conditions (e.g., macular degeneration) have more difficulty identifying colors than those with peripheral vision conditions (e.g., glaucoma) because central vision identifies color.

Amsler Grid

The Amsler grid is a test often used for patients with macular problems, such as macular degeneration. It consists of a geometric grid of identical squares with a central fixation point. The grid should be viewed by the patient wearing normal reading glasses. Each eye is tested separately. The patient is instructed to stare at the central fixation spot on the grid and report any distortion in the squares of the grid itself. For patients with macular problems, some of the squares may look faded, or the lines may be wavy. Patients with age-related macular degeneration (AMD) are commonly given these Amsler grids to take home. The patient is encouraged to check the grids frequently, as often as daily, to monitor macular function for early detection of changes requiring immediate attention (Gerstenblith & Rabinowitz, 2017); (Weber & Kelley, 2014).

Ultrasonography

Lesions in the globe or the orbit may not be directly visible and are evaluated by ultrasonography. Ultrasonography is a valuable diagnostic technique, especially when the view of the retina is obscured by opaque media such as cataract or hemorrhage. An ultrasonography B-scan identifies pathology such as orbital tumors, retinal detachment, and vitreous hemorrhage. Ultrasonography A-scans are used to measure the

axial length for implants prior to cataract surgery (Gerstenblith & Rabinowitz, 2017).

Optical Coherence Tomography

Optical coherence tomography is a technology that involves low-coherence interferometry (Boyd, 2015); (Gerstenblith & Rabinowitz, 2017). Light is used to evaluate retinal and macular diseases as well as anterior segment conditions. This method is noninvasive and involves no physical contact with the eye.

Fundus Photography

Fundus photography is used to detect and document retinal lesions. The patient's pupils are usually widely dilated before the procedure. The resulting fundus photographs can be viewed stereoscopically so that elevations such as macular edema can be identified.

Laser Scanning

Various scanning techniques use laser light in the diagnostic evaluation of eye disorders. Confocal laser scanning ophthalmoscopy provides a three-dimensional image of the optic nerve topography and is used alone or in conjunction with fundus photography to provide comparative data for suspected optic nerve disease such as glaucoma and papilledema (swelling of the optic disc due to increased intracranial pressure) (Gerstenblith & Rabinowitz, 2017). Laser scanning polarimetry is used to measure nerve fiber layer thickness and is an important indicator of glaucoma progression.

Angiography

Angiography is done using fluorescein or indocyanine green as contrast agents. Fluorescein angiography is used to evaluate clinically significant macular edema, document macular capillary nonperfusion, and identify retinal and choroidal neovascularization (growth of abnormal new blood vessels) in AMD. It is an invasive procedure in which fluorescein dye is injected, usually into an antecubital vein. Within 10 to 15 seconds, this dye can be seen coursing through the retinal vessels. Over a 10-minute period, serial black-and-white photographs are taken of the retinal vasculature.

Indocyanine green angiography is used to evaluate abnormalities in the choroidal vasculature, which often are seen in macular degeneration. Indocyanine green dye is injected intravenously (IV), and multiple images are captured using digital video angiography over a period of 30 seconds to 20 minutes.

Nursing Interventions

Prior to the angiography, the patient's blood urea nitrogen and creatinine should be checked to ensure that the kidneys will excrete the contrast agent (Fischbach & Dunning, 2015). The patient should be well hydrated, and clear liquids are usually permitted up to the time of the test. The patient is instructed to remain immobile during the angiogram process and is told to expect a brief feeling of warmth in the face, behind the eyes, or in the jaw, teeth, tongue, and lips, and a metallic taste when the contrast agent is injected.

Nursing care after angiography includes observation of the injection site (usually the antecubital vein) for bleeding or hematoma formation (a localized collection of blood). Fluorescein may impart a gold tone to the skin in some patients, and urine may turn deep yellow or orange. This discoloration usually disappears in 24 hours. Indocyanine green dye is generally well tolerated, but some patients experience nausea and vomiting. Allergic reactions are rare; however, indocyanine green angiography is contraindicated in patients with a history of iodide reactions. Fluids are encouraged following the procedure to facilitate excretion of the contrast agent (Fischbach & Dunning, 2015).

Perimetry Testing

Perimetry testing evaluates the field of vision. Visual field testing (i.e., perimetry) helps identify which parts of the patient's central and peripheral visual fields have useful vision. It is most helpful in detecting central scotomas (blind or partially blind areas in the visual field) in macular degeneration and the peripheral field defects in glaucoma and retinitis pigmentosa. Visual field evaluation and optic nerve assessment are major components of monitoring and detecting glaucoma progression.

IMPAIRED VISION

Refractive Errors

In refractive errors, vision is impaired because a shortened or elongated eyeball prevents light rays from focusing sharply on the retina. Blurred vision from refractive error can be corrected with eyeglasses or contact lenses. Ophthalmic refraction is the determination of the refractive errors of the eye for the purpose of vision correction and consists of placing various types of lenses in front of the patient's eyes to determine which lens best improves the patient's vision.

The depth of the eyeball is important in determining refractive error (see Fig. 42-5). Patients for whom the visual image focuses precisely on the macula and who do not need eyeglasses or

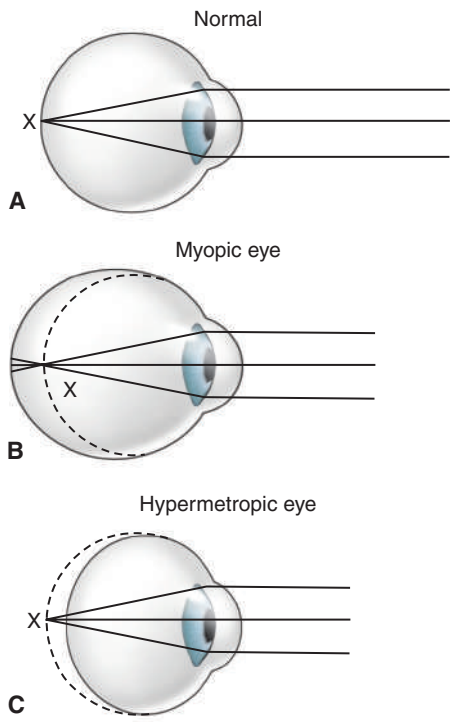


Figure 42-5 • Eyeball shape determines visual acuity in refractive errors. **A**. Normal eye. **B**. Myopic eye. **C**. Hypermetropic eye.

contact lenses are said to have emmetropia, a normal refractive condition resulting in clear focus on retina with no optical defects (normal vision). Some people have deeper eyeballs, in which case the distant visual image focuses in front of, or short of, the retina; those with myopia are said to be nearsighted and have blurred distance vision. Other people have shallower eyeballs, in which case the visual image focuses beyond the retina; those with hyperopia are said to be farsighted and have excellent distance vision but blurry near vision (Weber & Kelley, 2014).

Wavefront technology to measure unique refractive imperfections of the cornea or higher aberrations (i.e., myopia, hyperopia, astigmatism) can be used to customize laser-assisted in situ keratomileusis (LASIK) procedures. These procedures are described later in this chapter.

Vision Impairment and Blindness

Vision impairment is defined as having best corrected visual acuity of 20/40 or worse in the better-seeing eye. *Low vision* describes visual impairment that requires the use of devices and strategies to perform visual tasks.

Blindness is having best corrected visual acuity that can range from 20/400 to no light perception. The clinical definition of absolute blindness is the absence of light perception. Legal blindness is a condition of impaired vision in which a person has best corrected visual acuity that does not exceed 20/200 in the better eye or whose widest visual field diameter is 20 degrees or less (Prevent Blindness America, 2012). This definition neither equates with functional ability nor classifies the degrees of visual impairment. Legal blindness ranges from an inability to perceive light to having some vision remaining. A person who meets the criteria for legal blindness may be eligible for government financial assistance through disability.

Assessment and Diagnostic Testing

Assessment of vision impairment includes a thorough history and examination of distance and near visual acuity, visual field, contrast sensitivity, glare, color perception, and refraction. Specially designed, low vision visual acuity charts are used to evaluate patients.

Patient Interview

During history taking, the cause and duration of the patient's visual impairment are identified. Patients with retinitis pigmentosa, for example, have a genetic abnormality. Patients with diabetic macular edema typically have fluctuating visual acuity. Patients with macular degeneration have central acuity problems that cause difficulty in performing activities that require finer vision, such as reading. People with peripheral field defects have more difficulties with mobility. The patient's customary ADLs, medication regimen, habits (e.g., smoking), acceptance of the physical limitations brought about by the visual impairment, and realistic expectations of low vision aids are identified and included in the plan of care, as well as provision of guidelines for safety and referrals to social services.

Contrast-Sensitivity Testing and Glare Testing

Contrast-sensitivity testing measures visual acuity in different degrees of light and dark contrast to determine visual function. Glare testing is also used to determine visual function. Glare can reduce a person's ability to see, especially in patients with cataracts. Those affected by loss of contrast sensitivity and glare have difficulty functioning in low light, or driving at night or in foggy conditions. People with a loss of contrast sensitivity may benefit from better illumination.

Gerontologic Considerations

Approximately half of all individuals who are identified as legally blind each year are 65 years of age or older (Eliopoulos, 2018). With aging, structural and functional changes occur in the eye. Presbyopia, the loss of accommodative power in the lens, interferes with the ability to adequately focus and is the factor responsible for most older adults requiring some form of corrective lenses (Eliopoulos, 2018). Age-related changes in the eye are summarized in Table 42-1.

Impaired vision is often accompanied by difficulty in performing functional activities. People with visual acuity of 20/80 to 20/100 with a visual field restriction of 60 degrees to greater than 20 degrees can read at a nearly normal level with optical aids. Their visual orientation is near normal but requires increased scanning of the environment (i.e., systematic use of

TABLE 42-1 Age-Related Changes in the Eye

External Eye	Structural Change	Functional Change	History and Physical Findings
Eyelids and lacrimal structures	Loss of skin elasticity and orbital fat, decreased muscle tone; wrinkles develop	Lid margins turn in, causing entropion; or lid margins turn out, resulting in ectropion.	Reports of burning, foreign-body sensation, epiphora; injection, inflammation, and ulceration may occur.
Refractive changes; presbyopia	Loss of accommodative power in the lens with age	Reading materials must be held at increasing distance in order to focus.	Patient reports, "Arms are too short!"; need for increased light; reading glasses or bifocals needed.
Cataract	Opacities in the normally crystalline lens	Interference with the focus of a sharp image on the retina.	Patients report increased glare, decreased vision, changes in color values (blue and yellow especially affected).
Posterior vitreous detachment	Liquefaction and shrinkage of vitreous body	May lead to retinal tears and detachment.	Reports light flashes, cobwebs, floaters.
Age-related macular degeneration (AMD)	Drusen (yellowish aging spots in the retina) appear and coalesce in the macula. Abnormal choroidal blood vessels may lead to formation of fibrotic disciform scars in the macula	Central vision is affected; onset is more gradual in dry AMD, more rapid in wet AMD; distortion and loss of central vision may occur.	Reading vision is affected; words may be missing letters, faded areas appear on the page, straight lines may appear wavy; drusen, pigmentary changes in retina; abnormal submacular choroidal vessels.

Adapted from Eliopoulos, C. (2018). Gerontological nursing (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

head and eye movements). In a visual acuity range of 20/200 to 20/400 with a 20-degree to greater than 10-degree visual field restriction, the person can read slowly with optical aids.

The most common causes of blindness and visual impairment among adults 40 years and older are diabetic retinopathy, macular degeneration, glaucoma, and cataracts (Prevent Blindness America, 2012). Macular degeneration is more prevalent among Caucasians, whereas glaucoma is more prevalent among African Americans (Eliopoulos, 2018). The number of blind people in India is 8.8 million (Mascarenhas, 2017). Preventable conditions such as cataract and refractory errors are the major contributors (82.4%) of blindness.

Medical Management

Managing vision impairment involves magnification and image enhancement through the use of low vision aids and strategies, as well as referrals to social services and community agencies. The goals are to optimize the patient's remaining vision and assist the patient to perform customary activities. Table 42-2 presents low vision aids. Medications are prescribed for glaucoma. Ongoing research suggests that gene therapy may replace or be an adjunct to pharmacologic or surgical treatment for ocular disorders in the near future (Lee & Garg, 2015).

Nursing Management

Nurses need to increase their sensitivity to the challenges faced by patients with visual impairments. Coping with blindness involves emotional, physical, and social adaptation. The emotional adjustment to blindness or severe visual impairment determines the success of the physical and social adjustments of the patient. Successful emotional adjustment means acceptance of blindness or severe visual impairment.

Promoting Coping

Effective coping may not occur until the patient recognizes the permanence of the low vision or blindness. A patient who is newly visually impaired and their family members undergo the various steps of grieving: denial and shock, anger and protest, restitution, loss resolution, and acceptance. The ability to accept the changes that must come with visual loss and willingness to adapt to those changes influence the successful rehabilitation of the patient with vision loss. Additional aspects to consider are value changes, independence–dependence conflicts, coping with stigma, and learning to function in social settings without visual cues and landmarks.

Promoting Spatial Orientation and Mobility

A person who is blind or severely visually impaired requires strategies for adapting to the environment. ADLs, such as walking to a chair from a bed, require spatial concepts. The person needs to know where he or she is in relation to the rest of the room, to understand the changes that may occur, and to know how to approach the desired location safely. This requires a collaborative effort between the patient and the responsible adult who serves as the sighted guide. The nurse must assess the degree of physical assistance the person with vision loss requires and communicate this to other health care personnel.

The nurse should be aware of the importance of techniques in providing physical assistance, encouraging independence, and ensuring safety. Strategies for interacting with the patient with vision loss are presented in Chart 42-3. Research supports

TABLE 42-2 Activities Affected by Visual Impairment and Suggestions for Low Vision Aids

Activity	Optical Aids	Nonoptical Aids
Shopping	Hand magnifier	Lighting, color cues
Fixing a snack	Bifocals	Color cues; consistent food storage plan
Eating out	Hand magnifier	Flashlight, portable lamp
Identifying money	Bifocals, hand magnifier	Arrange paper money in wallet compartments
Reading print	High-power spectacle, bifocals, hand magnifier, stand magnifier, closed-circuit television	Lighting, high-contrast print, large print, reading slit
Writing	Hand magnifier	Lighting, bold-tip pen, black ink
Using a telephone	Hand magnifier	Large-print buttons, hand-printed directory Braille phones, picture/photo phones, and talking phones
Crossing streets	Lightweight handheld monoscopes/telescopes	Cane; ask directions
Finding taxis and bus signs	Lightweight handheld monoscopes/telescopes	Ask for assistance
Reading medication labels	Hand magnifier	Color codes, large print
Reading stove dials	Hand magnifier	Color codes, raised dots
Adjusting the thermostat	Hand magnifier	Enlarged-print model
Using a computer	Spectacles	High-contrast color, large-print program. Screen-reader programs convert text on the computer screen to synthesized speech
Reading signs	Spectacles	Move closer
Watching sporting event	Lightweight handheld monoscopes/telescopes	Sit in front rows

Adapted from Pagliuca, L. M., Macedo-Costa, K. N., Reboucas, G. B., et al. (2014).Validation of the general guidelines of communication between the nurse and the blind. Reviews Bras Enferm, 67(5), 715–725.

Chart 42-3

Strategies for Interacting with People who are Blind or have Low Vision

- Remember that the only difference between you and people who are blind or have low vision is that they are not able to see through their eyes what you are able to see through yours.
- Do not be uncomfortable when in the company of a person who is blind or has low vision. Talk with the person as you would talk with any other individual, honestly and without pity; do not be concerned about using words like "see" and "look." There is no need to raise your voice unless the person asks you to do so.
- Identify yourself as you approach the person and before you make physical contact. Tell the person your name and your role. If another person approaches, introduce him or her. When you leave the room, be sure to tell the person that you are leaving and if anyone else remains in the room.
- Keep in mind that it is often appropriate to touch the person's hand or arm lightly to indicate that you are about to speak.
- When talking, face the person and speak directly to him or her using a normal tone of voice.
- Be specific when communicating direction. Mention a specific distance or use clock cues when possible (e.g., walk left about 2 yards; walk about 20 feet to the right; the telephone is at 2 o'clock). Avoid using phrases such as "over there."
- When you offer to assist someone, allow the person to hold on to your arm just above the elbow and to walk a half-step behind you.
- When offering the person a seat, place the person's hand on the back or the arm of the seat.
- When you are about to go up or down a flight of stairs, tell the person and place their hand on the banister.
- Make sure that the environment is free of obstacles; close doors and cabinets so that they are not in the path.
- Offer to read written information, such as a menu.
- If you serve food to the person, use clock cues to specify where everything is on the plate.
- When the person who is blind or has low vision is a patient in a health care facility:
  - Make sure all objects the person will need are close at hand.
  - Identify the location of objects that the person may need (e.g., "The call light is near your right hand"; "The telephone is on the table on the left side of your bed.")
  - Remove obstacles that may be in the person's pathway and could cause a fall.
  - Place all assistive devices that the person uses close at hand; let the person feel the devices so that he or she knows their location.
- Ask the person, "How can I help you?" At some times, the person needs help; at other times, help may not be needed.

Adapted from Pagliuca, L. M., Macedo-Costa, K. N., Reboucas, G. B., et al. (2014). Validation of the general guidelines of communication between the nurse and the blind. Reviews Bras Enferm, 67(5), 715–725.

the use of a validated protocol to educate staff to perform therapeutic communication, deliver services, and minimize communication barriers with patients who are blind (Pagliuca, Macedo-Costa, Reboucas, et al., 2014). The readiness of the patient and family to learn must be assessed before initiating orientation and mobility training.

Promoting Home, Community-Based, and Transitional Care

The nurse, social worker, family, and others collaborate to assess the patient's home condition and support system. A low vision specialist or occupational therapist should be consulted, particularly for patients for whom identifying and administering medications pose challenges. Referral for vision rehabilitation should be provided for appropriate patients (American Academy of Ophthalmology Vision Rehabilitation Committee, 2012).

Other interventions that are appropriate for some people with visual impairment or blindness include Braille and. There has been an ever-increasing reliance on print magnification technology as well as computer-assisted speech output. However, although the use of Braille may be less important for adults who have already learned language and grammar skills, educators and low vision specialists have continued to advocate that children who are legally blind be given the opportunity to learn Braille.

OCULAR MEDICATION ADMINISTRATION

Because medications are often prescribed to treat ocular disorders, nurses must understand the actions of the commonly used medications and effective administration. The main objective of ocular medication delivery is to maximize the amount of medication that reaches the ocular site of action in sufficient concentration to produce a beneficial therapeutic effect. This is determined by the dynamics of ocular pharmacokinetics: absorption, distribution, metabolism, and excretion.

Ocular absorption involves the entry of a medication into the aqueous humor through the different routes of ocular medication administration. The rate and extent of aqueous humor absorption are determined by the characteristics of the medication and the anatomy and physiology of the eye. Natural barriers of absorption that diminish the efficacy of ocular medications include the following:

- *Limited size of the conjunctival sac.* The conjunctival sac can hold only 50 mcL, and any excess is wasted. The volume of one eye drop from commercial topical ocular solutions typically ranges from 20 to 35 mcL.
- *Corneal membrane barriers.* The epithelial, stromal, and endothelial layers are barriers to absorption.
- *Blood–ocular barriers.* Blood–ocular barriers prevent high ocular tissue concentration of most ophthalmic medications because they separate the bloodstream from the ocular tissues and keep foreign substances from entering the eye, thereby limiting a medication's efficacy.
- *Tearing, blinking, and drainage.* Increased tear production and drainage due to ocular irritation or an ocular condition may dilute or wash out an instilled eye drop; blinking expels an instilled eye drop from the conjunctival sac.

Distribution of an ocular medication into the various ocular tissues varies by tissue type—the conjunctiva, cornea, lens, iris, ciliary body, and choroids absorb medications to varying degrees. Medications penetrate the corneal epithelium by diffusion by passing through the cells (intracellular) or by passing between the cells (intercellular). Water-soluble (hydrophilic) medications diffuse through the intracellular route, and fat-soluble (lipophilic) medications diffuse through the intercellular route. Topical administration usually does not reach the retina in significant concentrations. Because the space

between the ciliary process and the lens is small, medication diffusion in the vitreous is slow. When high concentrations of medication in the vitreous are required, intraocular injection is often chosen to bypass the natural ocular anatomic and physiologic barriers (American Society of Ophthalmic Registered Nurses [ASORN], 2013).

Aqueous solutions are most commonly used for the eye. They are the least expensive medications and interfere the least with vision. However, corneal contact time is brief because tears dilute the medication. Ophthalmic ointments have extended retention time in the conjunctival sac and provide a higher concentration than eye drops. The major disadvantage of ointments is the blurred vision that results after application. In general, eyelids and eyelid margins are best treated with ointments. The conjunctiva, limbus, cornea, and anterior chamber are treated most effectively with instilled solutions or suspensions. Subconjunctival injection may be necessary for better absorption in the anterior chamber. If high medication concentrations are required in the posterior chamber, intravitreal injections or systemically absorbed medications are considered. Contact lenses and collagen shields soaked in antibiotic agents are alternative delivery methods for treating corneal infections.

Of all these delivery methods, the topical route of administration—instilled eye drops and applied ointments—remains the most common (ASORN, 2013). Topical instillation, which is the least invasive method, permits self-administration of medication and produces fewer side effects.

Preservatives are commonly used in ocular medications. Benzalkonium chloride, for example, prevents the growth of organisms and enhances the corneal permeability of most medications; however, some patients are allergic to this preservative. This may be suspected even if the patient had never before experienced an allergic reaction to systemic use of the medication in question. Eye drops without preservatives can be prepared by pharmacists.

Common Ocular Medications

Common ocular medications include topical anesthetic, mydriatic, and cycloplegic agents that reduce IOP; anti-infective medications; corticosteroids; nonsteroidal anti-inflammatory drugs (NSAIDs); antiallergy medications; eye irrigants; and lubricants.

Topical Anesthetic Agents

One or two drops of proparacaine hydrochloride (Ophthaine 0.5%) and tetracaine hydrochloride (Pontocaine 0.5%) are instilled before diagnostic procedures such as tonometry and minor ocular procedures such as removal of sutures or conjunctival or corneal scrapings. Topical anesthetic agents are also used for severe eye pain to allow the patient to open their eyes for examination or treatment (e.g., eye irrigation for chemical burns). Anesthesia occurs within 20 seconds to 1 minute and lasts 10 to 20 minutes. The nurse must educate the patient not to rub the eyes while anesthetized because this may result in corneal damage.

Mydriatic and Cycloplegic Agents

Mydriasis, or pupil dilation, is the main objective of the administration of mydriatics and cycloplegics (see Table 42-3). These two types of medications function differently and are used in combination to achieve the maximal dilation that is needed during surgery and fundus examinations to give the ophthalmologist a better view of the internal eye structures. Mydriatics potentiate alpha-adrenergic sympathetic effects that result in the relaxation of the ciliary muscle. This causes the pupil to dilate. However, this sympathetic action alone is not enough to sustain mydriasis because of its short duration of action. The strong light used during an eye examination also stimulates miosis (i.e., pupillary contraction). Cycloplegic medications are given to paralyze the iris sphincter.

TABLE 42-3 Mydriatics and Cycloplegics

Medication	Available Preparation/ Concentration	Indication/Dosage	Peak		Recovery Time	
			Mydriasis (Minutes)	Cycloplegia (Minutes)	Mydriasis	Cycloplegia
Phenylephrine (Neo-Synephrine)	Solutions (2.5%, 10%)	Given with cycloplegics in pupillary dilation for ophthalmoscopy and surgical procedures every 5–10 minutes × 3 or until the pupils are fully dilated	10–60	—	3–6 hours	—
Atropine (Isopto Ophthalmic)	Ointment (0.5–2%) Solutions (0.5–3%)	In uveitis, or after surgery, 2–4 × daily	30–40	60–180	7–10 days	6–12 days
Scopolamine (Isopto Hyoscine Ophthalmic)	Solution (0.25%)	Same as atropine	20–30	30–60	3–7 days	3–7 days
Homatropine (Homatropine HBr)	Solution (5–2.5%)	Same as atropine and scopolamine	40–60	30–60	1–3 days	1–3 days
Cyclopentolate (AK-Pentolate)	Solution (0.5–2%)	Given with mydriatics every 5–10 minutes × 3 or until the pupils are fully dilated for ophthalmoscopy and surgical procedures	30–60	25–75	1 day	6–24 hours
Tropicamide (Myrdal)	Solution (0.25–1%)		20–40	20–35	6 hours	<6 hours

Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

The patient is educated about the temporary effects of mydriasis on vision, such as glare and the inability to focus properly. The patient may have difficulty reading. The effects of the various mydriatics and cycloplegics can last 3 hours to several days. The patient is advised to wear sunglasses (most eye clinics provide protective sunglasses). The ability to drive depends on the person's age, vision, and comfort level. Some patients can drive safely with the use of sunglasses, whereas others may need to be driven home.

Mydriatic and cycloplegic agents affect the central nervous system. Their effects are most prominent in younger and older adult patients; these patients must be assessed closely for symptoms, such as increased blood pressure, tachycardia, dizziness, ataxia, confusion, disorientation, incoherent speech, and hallucination. These medications are contraindicated in patients with narrow angles or shallow anterior chambers and in patients taking monoamine oxidase inhibitors or tricyclic antidepressants.

Medications Used to Treat Glaucoma

Therapeutic medications for glaucoma are used to lower IOP by decreasing aqueous production or increasing aqueous outflow. Because glaucoma calls for lifetime therapy, the patient must be educated with regard to both the ocular and systemic side effects of the medications. See section on glaucoma later in this chapter.

Anti-Infective Medications

Anti-infective medications include antibiotic, antifungal, and antiviral agents. Most are available as drops, ointments, or subconjunctival or intravitreal injections. Antibiotics include penicillin, cephalosporins, aminoglycosides, and fluoroquinolones. The main antifungal agent is amphotericin B. Side effects of amphotericin are serious and include severe pain, conjunctival necrosis, iritis, and retinal toxicity. Antiviral medications include acyclovir (Zovirax) and ganciclovir (Cytovene). They are used to treat ocular infections associated with herpes virus and cytomegalovirus (CMV). Patients receiving ocular anti-infective agents are subject to the same side effects and adverse reactions as those receiving oral or parenteral medications.

Corticosteroids and Nonsteroidal Anti-Inflammatory Drugs

Topical preparations of corticosteroids are commonly used in inflammatory conditions of the eyelids, conjunctiva, cornea, anterior chamber, lens, and uvea. In posterior segment diseases that involve the posterior sclera, retina, and optic nerve, topical agents are less effective and parenteral and oral routes are preferred. When a suspension is prescribed, the patient is instructed to shake the bottle several times to promote mixture of the medication and maximize its therapeutic effect. The most common ocular side effects of long-term topical corticosteroid administration are glaucoma, cataracts, susceptibility to infection, impaired wound healing, mydriasis, and ptosis. High IOP may develop, which is reversible after corticosteroid use is discontinued. To avoid the side effects of corticosteroids, NSAIDs are used as an alternative in controlling inflammatory eye conditions and postoperatively to reduce inflammation.

Antiallergy Medications

Ocular hypersensitivity reactions, such as allergic conjunctivitis, are extremely common. These conditions result primarily from responses to environmental allergens. Most allergens are airborne or carried to the eye by the hand or by other means, although allergic reactions may also be drug induced. Corticosteroids are commonly used as anti-inflammatory and immunosuppressive agents to control ocular hypersensitivity reactions.

Ocular Irrigants and Lubricants

Most irrigating solutions are used to cleanse the external lids to maintain lid hygiene, to irrigate the external corneal surface to regain normal pH (e.g., in chemical burns), to irrigate the corneal surface to eliminate debris, or to inflate the globe intraoperatively. These solutions have various compositions that include sodium, potassium, magnesium, calcium, bicarbonate, glucose, and glutathione (i.e., substance found in the aqueous humor). Sterile irrigating solutions, such as Dacriose, for lid hygiene are available. Irrigating solutions are safe to use with an intact corneal surface; however, the corneal surface should not be irrigated in cases of threatened corneal perforation. For patients with severe corneal ulcer, specific instructions from the ophthalmologist must be obtained regarding whether it is safe to irrigate the corneal surface or just to cleanse the external lids. Although it is good practice to promote hygiene, prevention of complications must be the primary concern. Normal saline solutions are commonly used to irrigate the corneal surface when chemical burns occur.

Lubricants, such as artificial tears, help alleviate corneal irritation, such as dry eye syndrome. Artificial tears are topical preparations of carboxymethylcellulose or hydroxypropyl methylcellulose that are prepared as eye drop solutions, ointments, or ocular inserts (inserted at the lower conjunctival cul-de-sac once each day). The eye drops can be instilled as often as every hour, depending on the severity of symptoms.

Nursing Management

The objectives in administering ocular medications are to ensure proper administration to maximize the therapeutic effects and to ensure the safety of the patient by monitoring for systemic and local side effects (ASORN, 2013). Absorption of eye drops by the nasolacrimal duct is undesirable because of the potential systemic side effects of ocular medications. To diminish systemic absorption and minimize the side effects, it is important to occlude the puncta (see Chart 42-4). This is especially important for patients who are most vulnerable to medication overdose, including older adults; women who are pregnant or lactating; and patients with cardiac, pulmonary, hepatic, or kidney disease. A 5-minute interval between instillation of different types of ocular drops is recommended.

Before the administration of ocular medications, the nurse warns the patient that blurred vision, stinging, and a burning sensation are symptoms that ordinarily occur after instillation and are temporary. Risk for interactions of the ocular medication with other ocular and systemic medications must be emphasized; therefore, a careful patient interview regarding the medications being taken must be obtained.

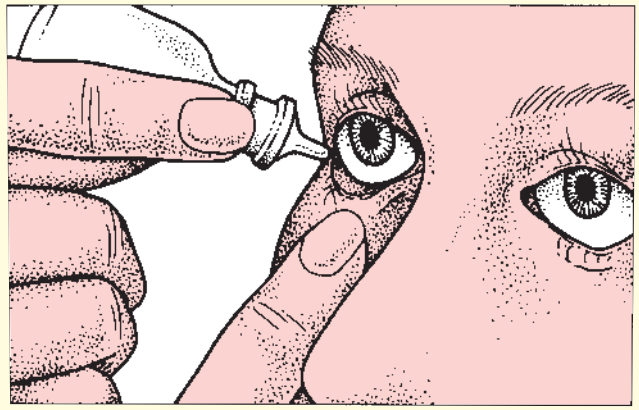
Nursing Alert: To prevent infection, meticulous hand hygiene before and after medication instillation is crucial. In addition, the tip of the eye drop bottle or the ointment tube must never touch any part of the eye, and the medication must be recapped immediately after each use.

Chart 42-4 PATIENT EDUCATION

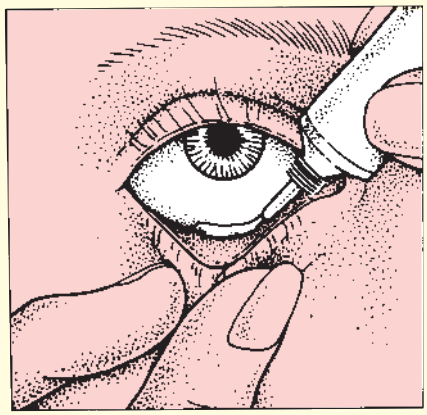
Instilling Eye Medications

The nurse instructs the patient to:

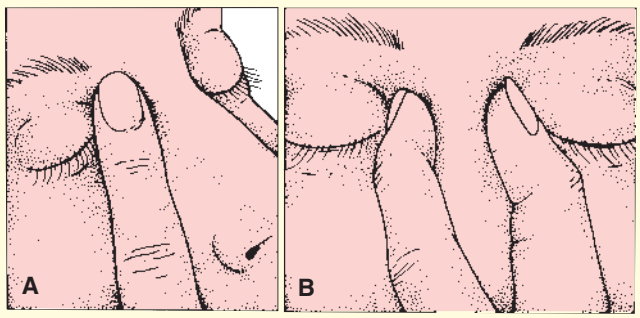
- Never use eye solutions that have changed colors.
- Perform hand hygiene before and after the procedure.
- Ensure adequate lighting.
- Read the label of the eye medication to verify that it is the correct medication.
- Remove contact lens as needed.
- Assume a comfortable position.
- Avoid touching the tip of the medication container to any part of the eye or face.
- Hold the lower lid down; do not press on the eyeball. Apply gentle pressure to the cheekbone to anchor the finger holding the lid.



- Instill eye drops before applying ointments.
- Apply a 0.25–0.5-inch ribbon of ointment to the lower conjunctival sac.



- Keep the eyelids closed, and apply gentle pressure on the inner canthus (punctal occlusion) near the bridge of the nose for 1 or 2 minutes immediately after instilling eye drops.
- Use a clean tissue to gently pat skin to absorb excess eye drops that run onto the cheeks.
- Wait 5 minutes before instilling another eye drop and 10 minutes before instilling another ointment.
- Reinsert contact lens if applicable.



Adapted from American Society of Ophthalmic Registered Nurses (ASORN). (2013). Recommended practice for registered nurses–Use of multi-dose medications. San Francisco, CA: Author; Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

If a patient who instills their own medications cannot feel the eye drops when they are instilled, the eye medication may be refrigerated, because a cold drop is easier to detect. A 5-minute interval between successive administrations allows adequate drug retention and absorption. The patient or the caregiver at home should be asked to demonstrate actual eye drop or ointment instillation and punctal occlusion.

GLAUCOMA

The term glaucoma is used to refer to a group of ocular conditions characterized by elevated IOP (Eldaly et al., 2014). If left untreated, the increased IOP damages the optic nerve and nerve fiber layer, but the degree of harm is highly variable (Eliopoulos, 2018). The optic nerve damage is related to the IOP caused by congestion of aqueous humor in the eye. A range of IOPs are considered "normal," but these may also be associated with vision loss in some patients.

Glaucoma is estimated to affect 3 million Americans, approximately 50% of whom are undiagnosed (Grossman & Porth, 2014). Glaucoma is more prevalent in people older than 40 years, and it is the third most common age-related eye disease in the United States. Chart 42-5 presents the risk factors for glaucoma. There is no cure for glaucoma, but the disease can be controlled (Glaucoma Research Foundation, 2016). Prevalence of glaucoma in people aged 40 plus in India varies between urban and rural population. Among urban population, the prevalence is about 3.23% and among rural Indians it is 2.7% (Paul, et al., 2016). The estimated number of people affected by glaucoma is 12 million in India (Saxena, Singh, & Vashist, 2013). Glaucoma is the third leading cause of blindness in India (5.8%).

Chart 42-5 RISK FACTORS

Glaucoma

- African American race
- Cardiovascular disease
- Diabetes
- Family history of glaucoma
- Migraine syndromes
- Nearsightedness (myopia)
- Older age
- Previous eye trauma
- Prolonged use of topical or systemic corticosteroids
- Thin cornea

Adapted from Grossman, S. C., & Porth, C. M. (2014). Porth's Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Physiology

Aqueous humor flows between the iris and the lens, nourishing the cornea and lens. Most (90%) of the fluid then flows out of the anterior chamber, draining through the spongy trabecular meshwork into the canal of Schlemm and the episcleral veins (see Fig. 42-6). About 10% of the aqueous fluid exits through the ciliary body into the suprachoroidal space and then drains into the venous circulation of the ciliary body, choroid, and sclera (Grossman & Porth, 2014). Unimpeded outflow of aqueous fluid depends on an intact drainage system and an open angle (about 45 degrees) between the iris and the cornea. A narrower angle places the iris closer to the trabecular meshwork, diminishing the angle. The amount of aqueous humor produced tends to decrease with age, in systemic diseases such as diabetes, and in ocular inflammatory conditions.

IOP is determined by the rate of aqueous production, the resistance encountered by the aqueous humor as it flows out of the passages, and the venous pressure of the episcleral veins that drain into the anterior ciliary vein. When aqueous fluid production and drainage are in balance, the IOP is between 10 and 21 mm Hg. When aqueous fluid is inhibited from flowing out, pressure builds up within the eye. Fluctuations in IOP occur with time of day, exertion, diet, and medications. IOP tends to increase with blinking, tight lid squeezing, and upward gazing. Systemic conditions such as diabetes and intraocular conditions such as uveitis and retinal detachment have been associated with elevated IOP. Glaucoma may not be recognized in people with thin corneas because measurement of the IOP may be falsely low as a result of this thinness.

Pathophysiology

There are two theories regarding how increased IOP damages the optic nerve in glaucoma. The direct mechanical theory suggests that high IOP damages the retinal layer as it passes through the optic nerve head. The indirect ischemic theory suggests that high IOP compresses the microcirculation in the optic nerve head, resulting in cell injury and death. Some glaucomas appear as exclusively mechanical, and some are exclusively ischemic types. Typically, most cases are a combination of both. Pathophysiological sequence of events of glaucoma is presented in Figure 42-7.

Classification of Glaucoma

There are several types of glaucoma. Forms of glaucoma are identified as wide-angle glaucoma; narrow-angle glaucoma;

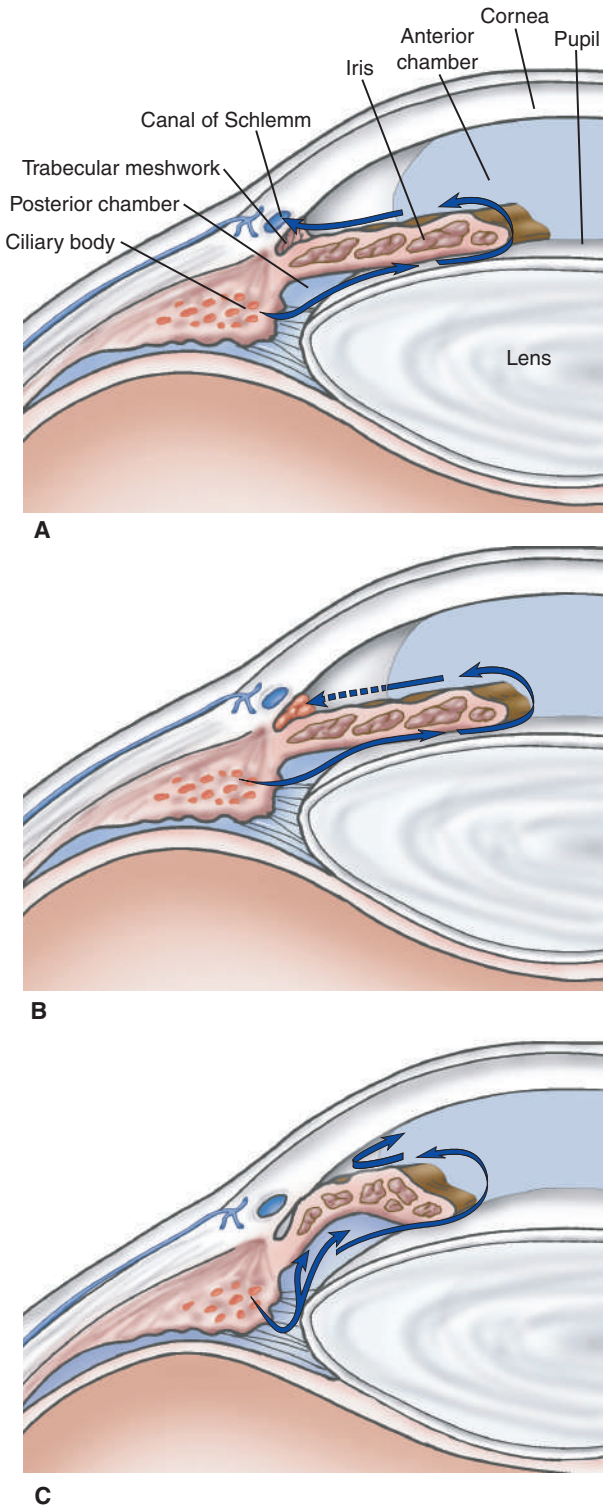


Figure 42-6 • A. Normally, aqueous humor, which is secreted in the posterior chamber, gains access to the anterior chamber by flowing through the pupil. In the angle of the anterior chamber, it passes through the canal of Schlemm into the venous system. **B.** In wide-angle glaucoma, the outflow of aqueous humor is obstructed at the trabecular meshwork. **C.** In narrow-angle glaucoma, the aqueous humor encounters resistance to flow through the pupil. Increased pressure in the posterior chamber produces a forward bowing of the peripheral iris so that the iris blocks the trabecular meshwork. Reprinted with permission from Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

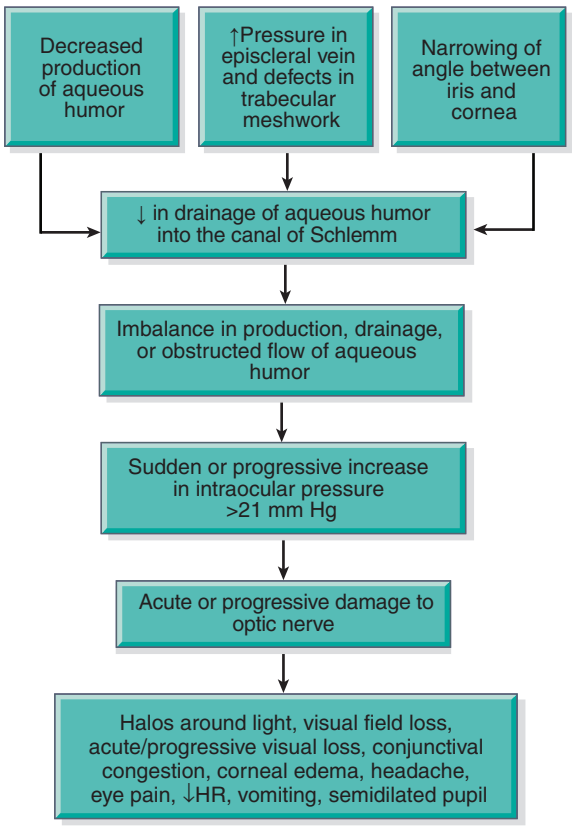


Figure 42-7 • Pathophysiological sequence of events in glaucoma.

congenital glaucoma; and glaucoma associated with other conditions, such as developmental anomalies or corticosteroid use. Glaucoma can be primary or secondary, depending on whether associated factors contribute to the rise in IOP. The two common clinical forms of glaucoma in adults are wide- and narrow-angle glaucoma, which are differentiated by the mechanisms that cause impaired aqueous outflow (Grossman & Porth, 2014). Table 42-4 summarizes the characteristics of the different types of adult glaucoma.

Clinical Manifestation

Glaucoma is often called the "silent thief of sight" because most patients are unaware that they have the disease until they have experienced visual changes and vision loss. The patient may not seek health care until he or she experiences blurred vision or "halos" around lights, difficulty focusing, difficulty adjusting eyes in low lighting, loss of peripheral vision, aching or discomfort around the eyes, and headache.

Assessment and Diagnostic Findings

The purpose of a glaucoma workup is to establish the diagnostic category, assess the optic nerve damage, and formulate a treatment plan. The patient's ocular and medical history must be detailed to investigate the history of predisposing factors. The types of examinations used in glaucoma include tonometry to measure the IOP, ophthalmoscopy to inspect the optic nerve, and central visual field testing (Glaucoma Research Foundation, 2016); (Grossman & Porth, 2014).

TABLE 42-4 Selected Glaucoma Types, Clinical Manifestation, and Treatment

Types of Glaucoma	Clinical Manifestations	Treatment
Wide Angle		
Usually bilateral, but one eye may be more severely affected than the other. In wide-angle glaucoma, the anterior chamber angle is open and appears normal.		
Normal tension glaucoma	IOP ≤21 mmHg. Optic nerve damage, visual field defects.	If medical treatment is unsuccessful, LT can decrease IOP by 20%. Glaucoma filtering surgery if continued optic nerve damage despite medication therapy and LT.
Ocular hypertension	Elevated IOP. Possible ocular pain or headache.	The best management for normal tension glaucoma management is yet to be established. Goal is to lower the IOP by at least 30%.
Narrow Angle		
Obstruction in aqueous humor outflow due to the complete or partial closure of the angle from the forward shift of the peripheral iris to the trabecula. The obstruction results in an increased IOP.		
Acute angle–closure glaucoma	Rapidly progressive visual impairment, periocular pain, conjunctival hyperemia, and congestion. Pain may be associated with nausea, vomiting, bradycardia, and profuse sweating. Reduced central visual acuity, severely elevated IOP, corneal edema. Pupil is vertically oval, fixed in a semidilated position, and unreactive to light and accommodation.	Ocular emergency; administration of hyperosmotics, acetazolamide, and topical ocular hypotensive agents, such as pilocarpine and beta-blockers (betaxolol). Possible laser incision in the iris (iridotomy) to release blocked aqueous and reduce IOP. Other eye is also treated with pilocarpine eye drops and/or surgical management to avoid a similar spontaneous attack.
Subacute angle–closure glaucoma	Transient blurring of vision, halos around lights; temporal headaches and/or ocular pain; pupil may be semidilated.	Prophylactic peripheral laser iridotomy. Can lead to acute or chronic angle–closure glaucoma if untreated.
Chronic angle–closure glaucoma	Progression of glaucomatous cupping and significant visual field loss; IOP may be normal or elevated; ocular pain and headache.	Management includes laser iridotomy and medications.

IOP, intraocular pressure; LT, laser trabeculoplasty.

Adapted from Eldaly, M. A., Bunce, C., El Sheikha, O. Z., et al. (2014). Non-penetrating filtration surgery versus trabeculectomy for open-angle glaucoma. Cochrane Database of Systematic Reviews, (2), CD007059. Grossman, S. C., & Porth, C. M. (2014). Porth's Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.



Figure 42-8 • Visual changes associated with glaucoma. Photo courtesy of the National Eye Institute, National Institutes of Health.

The changes in the optic nerve related to glaucoma are pallor and cupping of the optic nerve disc. The pallor of the optic nerve is caused by a lack of blood supply. Cupping is characterized by exaggerated bending of the blood vessels as they cross the optic disc, resulting in an enlarged optic cup that appears more basin like compared with a normal cup. The progression of cupping in glaucoma is caused by the gradual loss of retinal nerve fibers and the loss of blood supply.

As the optic nerve damage increases, visual perception decreases. The localized areas of visual loss (i.e., scotomas) represent loss of retinal sensitivity and nerve fiber damage and are measured and mapped on a graph. In patients with glaucoma, the graph has a distinct pattern that is different from other ocular diseases and is useful in establishing the diagnosis. Figure 42-8 shows the visual changes caused by glaucoma.

Medical Management

The aim of all glaucoma treatment is prevention of optic nerve damage. Lifelong therapy is necessary because glaucoma cannot be cured. Treatment focuses on pharmacologic therapy, laser procedures, surgery, or a combination of these approaches, all of which have potential complications and side effects. The object is to achieve the greatest benefit at the least risk, cost, and inconvenience to the patient. Although treatment cannot reverse optic nerve damage, further damage can be controlled. The goal is to maintain an IOP within a range unlikely to cause further damage (Eldaly et al., 2014).

The initial target for IOP among patients with elevated IOP and those with low-tension glaucoma with progressive visual field loss is typically set at 30% lower than the current pressure. The patient is monitored for changes in the appearance of the optic nerve. If there is evidence of progressive damage, the target IOP is again lowered until the optic nerve shows stability.

Pharmacologic Therapy

Medical management of glaucoma relies on systemic and topical ocular medications that lower IOP. Periodic follow-up examinations are essential to monitor IOP, the appearance of the optic nerve, the visual fields, and side effects of medications. Therapy takes into account the patient's health and stage of glaucoma. Comfort, affordability, convenience, lifestyle, and functional ability are factors to consider in the patient's adherence to the medical regimen (Eliopoulos, 2018).

The patient is usually started on the lowest dose of topical medication and then advanced to increased concentrations until the desired IOP level is reached and maintained. Beta-blockers are the preferred initial topical medications because of their efficacy, minimal dosing (can be used once each day), and low cost. One eye is treated first, with the other eye used as a control in determining the efficacy of the medication; once efficacy has been established, treatment of the other eye is started. If the IOP is elevated in both eyes, both are treated. When results are not satisfactory, a new medication is substituted. The main markers of the efficacy of the medication in glaucoma control are lowering of the IOP to the target pressure, stable appearance of the optic nerve head, and the visual field.

Many ocular medications are used to treat glaucoma (see Table 42-5), including miotics, beta-blockers, alpha$_2$-agonists (i.e., adrenergic agents), carbonic anhydrase inhibitors, and prostaglandins. Cholinergics (i.e., miotics) increase the outflow of the aqueous humor by affecting ciliary muscle contraction and pupil constriction, allowing flow through a larger opening between the iris and the trabecular meshwork. Beta-blockers and carbonic anhydrase inhibitors decrease aqueous production. Prostaglandin analogs reduce IOP by increasing aqueous humor outflow (Comerford, 2015); (Grossman & Porth, 2014).

Surgical Management

Surgery is reserved for patients in whom pharmacologic treatment has not controlled the IOP. This minimally invasive procedure is specifically designed to improve fluid drainage from the eye to balance IOP. By restoring the eye's natural fluid balance, trabeculectomy surgery stabilizes the optic nerve and minimizes further visual field damage (Eldaly et al., 2014). The surgery is performed through a small incision and does not require creation of a permanent hole in the eye wall or an external filtering bleb or an implant.

In laser trabeculoplasty for glaucoma, a laser beam is applied to the inner surface of the trabecular meshwork to open the intratrabecular spaces and widen the canal of Schlemm, promoting outflow of aqueous humor and decreasing IOP. The procedure is indicated when IOP is inadequately controlled by medications, and it is contraindicated when the trabecular meshwork cannot be fully visualized because of a narrow angle.

In peripheral iridotomy for pupillary block glaucoma, an opening is made in the iris to eliminate the pupillary blockage. Laser iridotomy is contraindicated in patients with corneal edema, which interferes with laser targeting and strength. Potential complications include burns to the cornea, lens, or retina; transient elevated IOP; closure of the iridotomy; uveitis; and blurring.

Filtering procedures for glaucoma are used to create an opening or fistula in the trabecular meshwork to drain aqueous humor from the anterior chamber to the subconjunctival space into a bleb (fluid collection on the outside of the eye), thereby bypassing the usual drainage structures. This allows the aqueous humor to flow and exit by different routes (i.e., absorption by the conjunctival vessels or mixing with tears). Trabeculectomy is the standard filtering technique used to remove part of the trabecular meshwork (Eldaly et al., 2014). Complications include hemorrhage, an extremely low (hypotony) or extremely elevated IOP, uveitis, cataracts, bleb failure, bleb leak, and endophthalmitis (i.e., intraocular infection).

Drainage implants or *shunts* are tubes implanted in the anterior chamber to shunt aqueous humor to the episcleral plate in the conjunctival space. Implants are used when failure

TABLE 42-5 Medications Used in the Management of Glaucoma

Medication	Action	Side Effects	Nursing Implications
Cholinergics (miotics) (pilocarpine, carbachol)	Increase aqueous fluid outflow by contracting the ciliary muscle and causing miosis (constriction of the pupil) and opening of trabecular meshwork	Periorbital pain, blurry vision, difficulty seeing in the dark	Caution patients about diminished vision in dimly lit areas. Pilocarpine can be stored at room temperature for up to 8 weeks and then should be discarded.
Beta-blockers (timolol maleate)	Decrease aqueous humor production	Can have systemic effects, including bradycardia, exacerbation of pulmonary disease, and hypotension	Contraindicated in patients with asthma, chronic obstructive pulmonary disease, 2nd- or 3rd-degree heart block, bradycardia, or cardiac failure; educate patients about punctal occlusion to limit systemic effects (see Chart 42-4).
Alpha-adrenergic agonists (apraclonidine, brimonidine)	Decrease aqueous humor production	Eye redness, dry mouth and nasal passages	Educate patients about punctal occlusion to limit systemic effects (see Chart 42-4).
Carbonic anhydrase inhibitors (acetazolamide, dorzolamide)	Decrease aqueous humor production	Oral medications (acetazolamide) are associated with serious side effects, including anaphylactic reactions, electrolyte loss, depression, lethargy, gastrointestinal upset, impotence, and weight loss; side effects of topical form (dorzolamide) include topical allergy	Do not administer to patients with sulfa allergies; monitor electrolyte levels.
Prostaglandin analogs (latanoprost, bimatoprost)	Increase uveoscleral outflow	Darkening of the iris, conjunctival redness, possible rash	Instruct patients to report any side effects.

Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

has occurred with one or more trabeculectomies in which antifibrotic agents were used. A fibrous capsule develops around the episcleral plate and filters the aqueous humor, thereby regulating the outflow and controlling IOP.

Nursing Management

Nurses in all settings encounter patients with glaucoma. Even patients with long-standing disease and those with glaucoma as a secondary diagnosis should be assessed for knowledge level and adherence to their prescribed therapeutic regimen.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

The medical and surgical management of glaucoma slows the progression of the disease but does not cure it. The lifelong therapeutic regimen mandates patient education. The nature of the disease and the importance of strict adherence to the medication regimen must be included in an individualized education plan. A structured self-management program may increase adherence to the treatment regime. A thorough discussion of the medication program, particularly the interactions of glaucoma-control medications with other medications, is essential. For example, the diuretic effect of acetazolamide (Diamox) may have an additive effect on the diuretic effects of other antihypertensive medications (Comerford, 2015). The effects of glaucoma-control medications on vision must also be explained. Miotics and sympathomimetics result in altered focus; therefore, patients need to be cautious in navigating their surroundings. Chart 42-4 presents patient education about instilling eye medications and preventing systemic absorption with punctal occlusion. Chart 42-6 contains additional educational information to review with patients with glaucoma.

Continuing and Transitional Care

Patients with severe glaucoma and impaired function may need referral to home, community-based or transitional services that provide assistance in the home. The loss of peripheral vision impairs mobility the most. These patients also benefit from a referral for low vision and rehabilitation services. Patients who meet the criteria for legal blindness should be offered referrals to agencies that can assist them in obtaining government assistance.

Reassurance and emotional support are important aspects of care. A lifelong disease involving possible loss of sight has psychological, physical, social, and vocational ramifications. The family must be integrated into the plan of care, and because the disease has a familial tendency, family members should be encouraged to undergo examinations at least once every 2 years to detect glaucoma early.

CATARACTS

A cataract is a lens opacity or cloudiness (see Fig. 42-9). Cataracts are responsible for visual disability in 18 million people worldwide (Grossman & Porth, 2014). By 80 years of age, more than half of all Americans have cataracts. Cataracts are a leading cause of blindness in the world (Prevent Blindness America, 2012). Cataract is the leading cause of blindness in India (62.7%) (National Program for Control of Blindness, 2018).

Chart 42-6 PATIENT EDUCATION

Managing Glaucoma

The nurse instructs the patient to:

- Know your intraocular pressure measurement and the desired range.
- Be informed about the extent of your vision loss and optic nerve damage.
- Keep a record of your eye pressure measurements and visual field test results to monitor your own progress.
- Review all of your medications (including over-the-counter and herbal medications) with your ophthalmologist, and mention any side effects each time you visit.
- Ask about potential side effects and drug interactions of your eye medications.
- Ask whether generic or less costly forms of your eye medications are available.
- Review the dosing schedule with your ophthalmologist, and inform him or her if you have trouble following the schedule.
- Participate in the decision-making process. Let your primary provider know what dosing schedule works for you and other preferences regarding your eye care.
- Have the nurse observe you instilling eye medication to determine whether you are administering it properly (see Chart 42-4).
- Be aware that glaucoma medications can cause adverse effects if used inappropriately. Eye drops are to be given as prescribed, not when eyes feel irritated.
- Ask your ophthalmologist to send a report to your primary provider after each appointment.
- Keep all follow-up appointments.

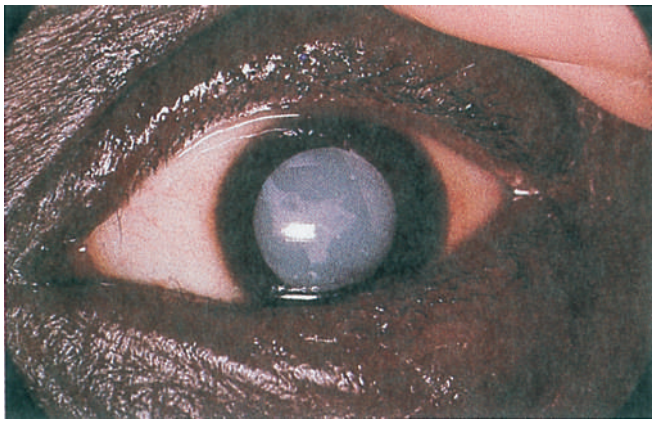


Figure 42-9 • A cataract is a cloudy or opaque lens. On visual inspection, the lens appears gray or milky. Reprinted with permission from Rubin, R., Strayer, D. S., & Rubin, E. (2012). Rubin's pathology: Clinicopathologic foundations of medicine (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Pathophysiology

Cataracts can develop in one or both eyes at any age. The three most common types are traumatic, congenital, or senile cataract (Grossman & Porth, 2014). There are a variety of risk factors, the most common one being age (see Chart 42-7).

Clinical Manifestations

Painless, blurry vision is characteristic of cataracts. The person perceives that surroundings are dimmer, as if their glasses need cleaning. Light scattering is common, and the person experiences reduced contrast sensitivity, sensitivity to glare, and reduced visual acuity. Other effects include myopic shift (return of ability to do close work [e.g., reading fine print] without eyeglasses), astigmatism (refractive error due to an irregularity in the curvature of the cornea), monocular diplopia (double vision), and color changes as lens becomes more brown in color (Cash & Glass, 2016); (Eliopoulos, 2018).

Assessment and Diagnostic Findings

Decreased visual acuity is directly proportionate to cataract density. The Snellen visual acuity test, ophthalmoscopy, and slit-lamp biomicroscopic examination are used to establish the degree of cataract formation. The degree of lens opacity does not always correlate with the patient's functional status. Some patients can perform normal activities despite clinically significant cataracts. Others with less lens opacification have a disproportionate decrease in visual acuity; hence, visual acuity is an imperfect measure of visual impairment.

Medical Management

No nonsurgical treatment (e.g., medications, eye drops, eyeglasses) cures cataracts or prevents age-related cataracts. Optimal medical management is prevention. Patients should be educated by primary providers about risk reduction strategies such as smoking cessation, weight reduction, optimal blood sugar control for patients with diabetes, and should be advised to wear sunglasses outdoors to prevent early cataract formation (Cash & Glass, 2016).

Surgical Management

In general, if reduced vision from cataract does not interfere with normal activities, surgery may not be needed. In deciding when cataract surgery is to be performed, the patient's functional and visual status should be a primary consideration (Eliopoulos, 2018). Cataract removal is common (Prevent Blindness America, 2012). Under the National Program for Control of Blindness, 6,324,490 cataract surgeries were performed in 2017–2018. Surgery is performed on an outpatient basis and usually takes less than 1 hour, with the patient being discharged in 30 minutes or less afterward. Although complications from cataract surgery are uncommon, they can have significant effects on vision (see Table 42-6). Restoration of visual function through a safe and minimally invasive procedure is the surgical goal, which is achieved with advances in topical anesthesia, smaller wound incision (i.e., clear cornea incision), and lens design (i.e., foldable and more accurate intraocular lens [IOL] measurements).

Injection-free topical and intraocular anesthesia, such as 1% lidocaine gel applied to the surface of the eye, eliminates the hazards of regional (retrobulbar and peribulbar) anesthesia, such as ocular perforation, retrobulbar hemorrhage, optic injuries, diplopia, and ptosis, and is ideal for patients receiving anticoagulants. Furthermore, patients can communicate and

Chart 42-7 RISK FACTORS

Cataract Formation

Aging

- Accumulation of a yellow-brown pigment due to the breakdown of lens protein
- Clumping or aggregation of lens protein (which leads to light scattering)
- Decreased oxygen uptake
- Decrease in levels of vitamin C, protein, and glutathione (an antioxidant)
- Increase in sodium and calcium
- Loss of lens transparency

Associated Ocular Conditions

- Infection (e.g., herpes zoster, uveitis)
- Myopia
- Retinal detachment and retinal surgery
- Retinitis pigmentosa

Toxic Factors

- Alkaline chemical eye burns, poisoning
- Aspirin use
- Calcium, copper, iron, gold, silver, and mercury, which tend to deposit in the pupillary area of the lens
- Cigarette smoking
- Corticosteroids, especially at high doses and in long-term use
- Ionizing radiation

Nutritional Factors

- Obesity
- Poor nutrition
- Reduced levels of antioxidants

Physical Factors

- Blunt trauma, perforation of the lens with a sharp object or foreign body, electric shock
- Dehydration associated with chronic diarrhea, the use of purgatives in anorexia nervosa, and the use of hyperbaric oxygenation
- Ultraviolet radiation in sunlight and x-ray

Systemic Diseases and Syndromes

- Diabetes
- Disorders related to lipid metabolism
- Down syndrome
- Musculoskeletal disorders
- Renal disorders

Adapted from Grossman, S. C., & Porth, C. M. (2014). Porth's Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Kumar, C. M., Seet, E., Eke, T., et al. (2016). Glycaemic control during cataract surgery under loco-regional anesthesia: A growing problem and we are none the wiser. British Journal of Anesthesia, 117(6), 687–691.

cooperate during surgery. IV moderate sedation may be used to minimize anxiety and discomfort.

When both eyes have cataracts, one eye is treated first, with at least several weeks, preferably months, separating the two procedures. Because cataract surgery is performed to improve visual functioning, the delay for the other eye gives time for the patient and the surgeon to evaluate whether the results from the first surgery are adequate to preclude the need for a second operation. The delay also provides time for the first eye to recover; if there are any complications, the surgeon may decide to perform the second procedure differently.

Phacoemulsification

In this method of extracapsular cataract surgery, a portion of the anterior capsule is removed, allowing extraction of the lens nucleus and cortex while the posterior capsule and zonular support are left intact. An ultrasonic device is used to liquefy the nucleus and cortex, which are then suctioned out through a tube. An intact zonular–capsular diaphragm provides the needed safe anchor for the posterior chamber IOL. The pupil is dilated to 7 mm or greater (Peng, Fong, Phaik, et al., 2012). The surgeon makes a small incision on the upper edge of the cornea and a viscoelastic substance (clear gel) is injected into the space between the cornea and the lens. This prevents the space from collapsing and facilitates insertion of the IOL. Because the incision is smaller than the manual extracapsular cataract extraction, the wound heals more rapidly, and there is early stabilization of refractive error and less astigmatism.

Lens Replacement

After removal of the crystalline lens, the patient is referred to as aphakic (i.e., without lens). The lens, which focuses light on the retina, must be replaced for the patient to see clearly. There are three lens replacement options: aphakic eyeglasses, contact lenses, and IOL implants.

Aphakic glasses, although effective, are rarely used. Objects are magnified by 25%, making them appear closer than they actually are. This magnification creates distortion. Peripheral vision is also limited, and binocular vision (i.e., ability of both eyes to focus on one object and fuse the two images into one) is impossible if the other eye is aphakic (without a natural lens).

Contact lenses provide patients with almost normal vision, but because contact lenses need to be removed occasionally, the patient also needs a pair of aphakic glasses. Contact lenses are not advised for patients who have difficulty inserting, removing, and cleaning them. Frequent handling and improper disinfection increase the risk of infection.

Insertion of IOLs during cataract surgery is the most common approach to lens replacement (Eliopoulos, 2018). After cataract extraction, or phacoemulsification, the surgeon implants an IOL. Cataract extraction and posterior chamber IOLs are associated with a relatively low incidence of complications (e.g., eye infection, loss of vitreous humor, and slipping of the implant) (Eliopoulos, 2018). IOL implantation is contraindicated in patients with recurrent uveitis, proliferative diabetic retinopathy, neovascular glaucoma, or rubeosis iridis.

Nursing Management

Providing Preoperative Care

The patient with cataracts receives the usual preoperative care for ambulatory surgical patients undergoing eye surgery. The standard battery of preoperative tests (e.g., complete blood

TABLE 42-6 Potential Complications of Cataract Surgery

Complication	Effects	Management and Outcome
Immediate Preoperative		
Retrobulbar hemorrhage—can result from retrobulbar infiltration of anesthetic agents if the short ciliary artery is located by the injectia	Increased IOP, proptosis, lid tightness, and subconjunctival hemorrhage with or without edema	Emergent lateral canthotomy (slitting of the canthus) is performed to stop central retinal perfusion when the IOP is dangerously elevated. If this procedure fails to reduce IOP, a puncture of the anterior chamber with removal of fluid is considered. The patient must be closely monitored for at least a few hours. Postponement of cataract surgery for 2–4 weeks is advised. Complications such as iris prolapse, vitreous loss, and choroidal hemorrhage could result in a catastrophic visual outcome.
Intraoperative		
Rupture of the posterior capsule	May result in loss of vitreous	Anterior vitrectomy is required if vitreous loss occurs.
Suprachoroidal (expulsive) hemorrhage—profuse bleeding into the suprachoroidal space	Extrusion of intraocular contents from the eye or opposition of retinal surfaces	Closure of the incision and administration of a hyperosmotic agent to reduce IOP or corticosteroids to reduce intraocular inflammation. Vitrectomy is performed 1–2 weeks later. Visual prognosis is poor; some useful vision may be salvaged on rare occasions.
Early Postoperative		
Acute bacterial endophthalmitis—devastating complication that occurs in about 1 in 1000 cases; the most common causative organisms are *Staphylococcus epidermidis, Staphylococcus aureus, Pseudomonas,* and *Proteus* species	Characterized by marked visual loss, pain, lid edema, hypopyon, corneal haze, and chemosis	Managed by aggressive antibiotic therapy. Broad-spectrum antibiotics are given while awaiting culture and sensitivity results. Once results are obtained, the appropriate antibiotics are given via intravitreal injection. Corticosteroid therapy is also given.
Toxic anterior segment syndrome—noninfectious inflammation that is a complication of anterior chamber surgery; caused by a toxic agent such as an agent used to sterilize surgical instruments	Corneal edema occurs <24 hours after surgery; symptoms include reduced visual acuity and pain	If there is no growth of microorganisms, the treatment is topical steroids alone.
Late Postoperative		
Suture-related problems	Toxic reactions or mechanical injury from broken or loose sutures	Suture removal relieves the symptoms. Topical corticosteroids are used when the incision is not healed and sutures cannot be removed.
Malposition of the IOL	Results in astigmatism, sensitivity to glare, or appearance of halos	Miotics are used for mild cases, whereas IOL removal and replacement is necessary for severe cases.
Chronic endophthalmitis	Persistent, low-grade inflammation, and granuloma	Corticosteroids and antibiotics are given systemically. If the condition persists, removal of the IOL and capsular bag, vitrectomy, and intravitreal injection of antibiotics are required.
Opacification of the posterior capsule—most common late complication of extracapsular cataract extraction	Visual acuity is diminished	Nd:YAG laser is used to create a hole in the posterior capsule. Blurred vision is cleared immediately.

IOL, intraocular lens; IOP, intraocular pressure; Nd:YAG, Neodymium: yttrium aluminum garnet.

count, electrocardiogram, and urinalysis) commonly performed for most surgeries is prescribed only if indicated by the patient's medical history.

Alpha-antagonists (particularly tamsulosin [Flomax], which is used for treatment of enlarged prostate) are known to cause a condition called *intraoperative floppy iris syndrome.* Alpha-antagonists can interfere with pupil dilation during the surgical procedure, resulting in miosis and iris prolapse and leading to complications. Intraoperative floppy iris syndrome can occur even though a patient has stopped taking the drug. The nurse needs to ask patients about a history of taking alpha-antagonists. Surgical team members are then alerted to the risk of this complication (Comerford, 2015).

Dilating drops are given prior to surgery. Nurses in the ambulatory surgery setting begin patient education about eye medications (antibiotic, corticosteroid, and anti-inflammatory drops) that will need to be self-administered to prevent postoperative infection and inflammation.

Providing Postoperative Care

Before discharge, the patient receives verbal and written education regarding eye protection, administration of medications, recognition of complications, activities to avoid, and obtaining emergency care (see Chart 42-8). An eye shield is usually worn at night for the first week to avoid injury. The nurse also explains that there should be minimal discomfort

Chart 42-8 HOME CARE CHECKLIST

Intraocular Lens Implant

At the completion of education, the patient and/or caregiver will be able to:

- Name the procedure that was performed and identify any permanent changes in anatomic structure or function as well as changes in ADLs, IADLs, roles, relationships, and spirituality.
- State the name, dose, side effects, frequency, and schedule for all medications.
- Describe ongoing postoperative therapeutic regimen and activities to limit or avoid (e.g., lifting weights, driving a car, contact sports).
  - Wear glasses or eye shield following surgery as instructed.
  - Always wash hands before touching or cleaning the postoperative eye.
  - Clean postoperative eye with a clean tissue; wipe the closed eye with a single gesture from the inner canthus outward.
  - When bathing or showering, shampoo hair cautiously or seek assistance.
  - Avoid lying on the side of the affected eye the night after surgery.
  - Keep activity light (e.g., walking, reading, watching television). Resume the following activities only as directed by the ophthalmologist: driving, sexual activity, unusually strenuous activity.
  - Avoid lifting, pushing, or pulling objects heavier than 6 kg.
  - Avoid bending or stooping for an extended period.
  - Be careful when climbing or descending stairs.
- Describe signs and symptoms of complications (e.g., vision change, continuous flashing lights appear to the affected eye, redness, swelling or increased pain near the eye, change in amount or type of eye drainage, any eye injury, significant pain not relieved by prescribed analgesia).
- Relate how to reach ophthalmologist with questions or complications.
- State time and date of follow-up appointments.
- Identify sources of assistance (e.g., meals, transportation) and support (e.g., friends, relatives, faith community).
- Identify the need for health promotion, disease prevention, and screening activities

ADL, activities of daily living; IADL, independent activities of daily living.

after surgery and educates the patient about taking a mild analgesic agent, such as acetaminophen/paracetamol, as needed. Antibiotic, anti-inflammatory, and corticosteroid eye drops or ointments are prescribed postoperatively. Patients prescribed anti-inflammatory or corticosteroid eye drops are monitored for possible increases in IOP (Kusne, Kang, & Fintelmann, 2016).

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

To prevent accidental rubbing or poking of the eye, the patient wears a protective eye patch for about the first 24 hours after surgery, followed by eyeglasses worn during the day and an eye shield at night. The nurse educates the patient and family about applying and caring for the eye shield, if one is recommended. Sunglasses should be worn while outdoors during the day because the eye is sensitive to light.

Slight morning discharge, some redness, and a scratchy feeling may be expected for a few days. A clean, damp washcloth may be used to remove slight morning eye discharge. Because cataract surgery increases the risk of retinal detachment, the patient must know to notify the surgeon if new floaters (dots) in vision, flashing lights, decrease in vision, pain, or increase in redness occurs.

Continuing and Transitional Care

If an eye patch is worn, it is removed after the first follow-up appointment, which should occur within 48 hours of surgery. Nurses should educate patients about the importance of keeping their follow-up appointments, because monitoring of visual status and prompt intervention of postoperative complications enhance good visual outcome. Vision is stabilized when the eye is completely healed, usually within 6 to 12 weeks, when final corrective prescription is completed. Visual correction may still be needed for any remaining refractive errors. Patients who choose multifocal IOLs should be aware that there may be increased night glare and contrast sensitivity.

CORNEAL DISORDERS

Corneal Dystrophies

Corneal dystrophies are inherited as autosomal dominant traits and manifest when the person is about 20 years of age. They are characterized by deposits in the corneal layers. Decreased vision is caused by the irregular corneal surface and corneal deposits. Corneal endothelial decomposition leads to corneal edema and blurring of vision. Persistent edema leads to bullous keratopathy or the formation of blisters that cause pain and discomfort on rupturing. The two main types are keratoconus and Fuchs endothelial dystrophy.

Keratoconus

Keratoconus, the most common type of corneal dystrophy, is characterized by a conical protuberance of the cornea with progressive thinning on protrusion and irregular astigmatism. This hereditary condition has a higher incidence among women. Onset occurs at puberty; the condition may progress for more than 20 years and is bilateral. Corneal scarring occurs in severe cases. Blurred vision is a prominent symptom. Rigid, gas-permeable contact lenses correct irregular astigmatism and improve vision. Advances in contact lens design have reduced the need for surgery. Penetrating keratoplasty (PKP) is indicated when contact lens correction is no longer effective.

Fuchs Endothelial Dystrophy

Fuchs (pronounced *Fooks*) dystrophy is manifested by a slow death of cells in the endothelial cornea. It affects women more than men and is usually not noted until 50 years of age. Corneal endothelial cell death leads to corneal edema and blurring of vision. Persistent edema leads to bullous keratopathy. A bandage contact lens is used to flatten the bullae, protect the exposed corneal nerve endings, and relieve discomfort. Symptomatic treatments, such as hypertonic drops or ointment (5% sodium chloride), may reduce

epithelial edema. Currently, the only cure is a corneal transplant (Dickman, Peeters, Van Den Biggelaar, et al., 2016).

Corneal Surgeries

Among the surgical procedures used to treat diseased corneal tissue are phototherapeutic keratectomy (PTK), PKP and corneal endothelial transplantation, and Descemet's stripping endothelial keratoplasty (DSEK).

Phototherapeutic Keratectomy

PTK is a laser procedure that is used to treat diseased corneal tissue by removing or reducing corneal opacities and smoothing the anterior corneal surface to improve functional vision. PTK is contraindicated in patients with active herpetic keratitis because the ultraviolet rays may reactivate latent virus. Common side effects are induced hyperopia and stromal haze. Complications are delayed re-epithelialization (particularly in patients with diabetes) and bacterial keratitis. Postoperative management consists of oral analgesic agents for eye pain. Re-epithelialization is promoted with a pressure patch or therapeutic soft contact lens. Antibiotic and corticosteroid ointments and NSAIDs are prescribed postoperatively. Follow-up examinations are required for up to 2 years.

Penetrating Keratoplasty

PKP (corneal transplantation or corneal grafting) involves replacing abnormal host tissue with healthy donor (cadaver) corneal tissue. Common indications are keratoconus, corneal scarring from herpes simplex, keratitis, and chemical burns.

Several factors affect the success of the graft: the condition of the ocular structures (e.g., lids, conjunctiva), quality of the tears, adequacy of blinking, and viability of the donor endothelium. Contraindications for the use of donor tissue are outlined in Chart 42-9.

In PKP, the surgeon determines the graft size before the procedure, and the appropriate size is marked on the surface of the cornea. The surgeon prepares the donor cornea and the recipient bed, removes the diseased cornea, places the donor cornea on the recipient bed, and sutures it in place. Sutures remain in place for 12 to 18 months and are then removed. Potential complications include early graft failure due to poor quality of donor tissue, surgical trauma, acute infection, and persistently increased IOP and late graft failure due to rejection.

Postoperatively, the patient receives mydriatics for 2 weeks and topical corticosteroids for 12 months (daily doses for 6 months and tapered doses thereafter). These mydriatics and corticosteroid drops should be preservative free to prevent a reactive inflammation. Patients typically describe a sensation of postoperative eye discomfort rather than acute pain.

Additional Keratoplasty Surgeries

For many years, PKP was the standard of care for patients with corneal endothelial failure but with poor refractive results. Subsequently, other techniques have been developed. Anterior lamellar keratoplasty (ALK) involves a partial-thickness graft for disorders such as anterior corneal dystrophies or scarring not involving the endothelial portion of the cornea. Deep anterior lamellar keratoplasty (DALK) involves replacement of only anterior corneal layers and not Descemet's membrane or endothelial layers for disorders such as keratoconus. Posterior lamellar keratoplasty (PLK or EK) and DSEK (which replaces only the endothelial layer of the cornea) are procedures indicated for conditions such as Fuchs endothelial dystrophy or bullous keratopathy (Dickman, et al., 2016). In DSEK, layers of the cornea are dissected and selectively replaced by donor cornea tissue. DSEK offers several advantages, such as less postoperative astigmatism, faster visual recovery, and stronger wound integrity. Theoretically, the risk of rejection is less because less of the patient's tissue is replaced.

Chart 42-9

Contraindications to the Use of Donor Tissue for Corneal Transplantation: Donor Characteristics

Systemic Disorders

- Death from unknown cause
- History or suspected history of the following:
  - Acquired immune deficiency syndrome or high-risk for human immune deficiency virus infection
  - Creutzfeldt–Jakob disease
  - Eye infection
  - Hepatitis
  - Rabies
  - Systemic infection

Intrinsic Eye Disease

- Disorders of the conjunctiva or corneal surface involving the optical zone of the cornea
- Malignant tumors of anterior segment
- Ocular inflammation
- Retinoblastoma

Other

- Corneal scars
- History of eye trauma
- Previous surgical eye procedures such as corneal graft or LASIK eye surgery

Keratoprosthesis

An additional therapeutic option for patients with multiple graft failures or severe corneal disease is keratoprosthesis (artificial cornea; e.g., U.S. Food and Drug Administration [FDA]-approved Boston Keratoprosthesis [KPro] and AlphaCor). The design of the keratoprosthesis consists of a central optic core and an outer rim that secures the prosthesis. This procedure has serious potential complications (e.g., glaucoma, endophthalmitis) and requires close follow-up and monitoring (Patel, Moster, Kishfy, et al., 2016).

Nursing Management

For corneal surgeries, the nurse reinforces instructions regarding visual rehabilitation and visual improvement. A technically successful graft may initially produce disappointing results because the procedure has produced a new optical surface. Only after several months do patients start seeing the natural and true colors of their environment. Correction of a resultant refractive error with eyeglasses or contact lenses determines the final visual outcome. The nurse assesses the patient's support system and their ability to comply with long-term follow-up, which includes frequent clinic visits for several months for tapering of topical corticosteroid therapy, selective suture removal, and ongoing evaluation of the graft site and visual acuity. The nurse also initiates appropriate referrals to community services as indicated.

Because graft failure is an ophthalmic emergency that can occur at any time, the primary goal of nursing care is to educate the patient to identify signs and symptoms of graft failure. The early symptoms are blurred vision, discomfort, tearing, or redness of the eye. Decreased vision results after graft destruction. The patient must contact the ophthalmologist as soon as symptoms occur. Treatment of graft rejection usually involves prompt administration of hourly topical corticosteroids and periocular corticosteroid injections. Systemic immunosuppressive agents may be necessary for severe, resistant cases.

Refractive Surgeries

Refractive surgeries are elective procedures performed to correct refractive errors (myopia or hyperopia) and astigmatism by reshaping the cornea (Li, Zhan, Li, et al., 2016). Laser vision correction alters the major optical function of the eye and carries risks. Refractive surgery does not alter the normal aging process of the eye. If the reason for the procedure is to meet vision requirements for the patient's occupation, the results must satisfy both the patient and the employer. Precise visual outcome cannot be guaranteed.

The corneal structure must be normal, and the refractive error must be stable. The patient is required to discontinue using contact lenses for a period before the procedure (2 to 3 weeks for soft lenses and 4 weeks for hard lenses). Patients with conditions that are likely to adversely affect corneal wound healing (e.g., corticosteroid use, immunosuppression, elevated IOP) are not good candidates for the procedure. Any superficial eye disease must be diagnosed and fully treated before a refractive procedure.

Patient satisfaction is the ultimate goal; therefore, patient education and counseling about potential risks, complications, and postoperative follow-up are critical. Minimal postoperative care includes topical corticosteroid or NSAID and antibiotic drops.

Laser Vision Correction Photorefractive Keratectomy

Photorefractive keratectomy (PRK) is used to treat myopia and hyperopia with or without astigmatism (Li et al., 2016). The excimer laser is applied directly to the cornea according to carefully calculated measurements. For myopia, the relative curvature is decreased; for hyperopia, the relative curvature is increased. A bandage contact lens is placed over the cornea to promote epithelial healing and reduce pain, which is similar to that of a severe corneal abrasion.

Laser-Assisted In Situ Keratomileusis

LASIK involves flattening the anterior curvature of the cornea by removing a stromal lamella or layer. The surgeon creates a corneal flap with a microkeratome, which is an automatic corneal shaper. The surgeon retracts a flap of corneal tissue less than one third the thickness of a human hair to access the corneal stroma and then uses the excimer laser on the stromal bed to reshape the cornea according to calculated measurements (see Fig. 42-10). Data are insufficient to determine whether LASIK or PRK is better at correcting near-sightedness (Li et al., 2016). There are few adverse outcomes of either procedure.

Perioperative Complications

Surgically Induced Abnormalities

Corneal surface irregularities can occur after LASIK treatment. These include central islands (central areas of stiffness or elevation), decentered ablations resulting from misalignment of the laser treatment or from involuntary eye movement during laser treatment, and forms of irregular astigmatism. Symptoms of central islands and decentered ablations include monocular diplopia or ghost images, halos, glare, and decreased visual acuity.

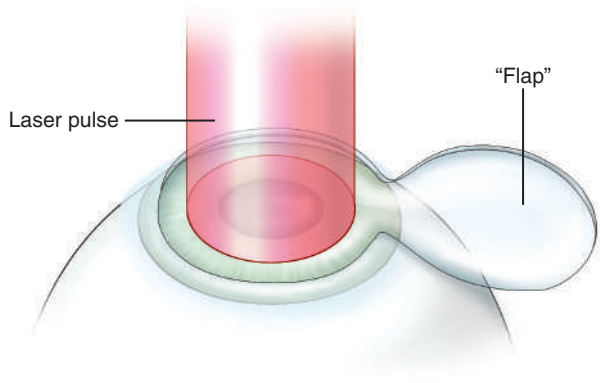


Figure 42-10 • LASIK combines delicate surgical procedures and laser treatment. A flap is surgically created and lifted to one side. A laser is then applied to the cornea to reshape it. With permission from the Wilmer Laser Vision Center, Lutherville, MD.

Phakic Intraocular Lenses

Increasingly, phakic IOL implantation has been used for patients with moderate to severe myopia (Barsam & Allan, 2014). Phakic IOLs may be used in either the anterior or posterior chamber. The implantation of such devices is reversible because the natural lens is left in place and the normal architecture of the cornea is preserved. This procedure provides more predictable refractive results than procedures that alter the corneal curvature, is safer, and has higher patient satisfaction scores (Barsam & Allan, 2014). Potential complications include cataract, iritis or uveitis, endothelial cell loss, and increased IOP.

Conductive Keratoplasty

Another innovation in refractive surgery for the correction of low to mild hyperopia uses the principles of thermal keratoplasty by applying radiofrequency current to the peripheral cornea using a thin, handheld probe. It does not involve the removal of cornea tissue.

RETINAL DISORDERS

Although the retina is composed of multiple microscopic layers, the two innermost layers—the sensory retina and the RPE—are most commonly implicated in retinal disorders (Grossman & Porth, 2014).

Retinal Detachment

Retinal detachment refers to the separation of the RPE from the neurosensory layer (Grossman & Porth, 2014). The four types of retinal detachment are rhegmatogenous, traction, a combination of rhegmatogenous and traction, and exudative. *Rhegmatogenous detachment* is the most common form. In this condition, a hole or tear develops in the sensory retina, allowing some of the liquid vitreous to seep through the sensory retina and detach it from the RPE (see Fig. 42-11). People at risk for

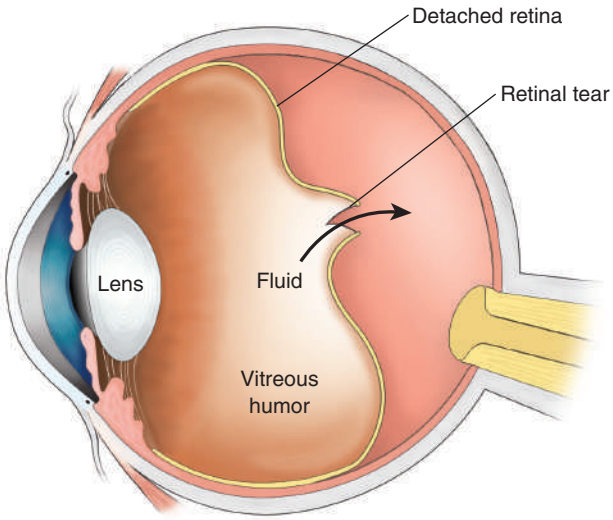


Figure 42-11 • Retinal detachment.

this type of detachment include those with high myopia or those who have aphakia (absence of the natural lens) after cataract surgery. Trauma may also play a role in rhegmatogenous retinal detachment. Between 5% and 10% of all rhegmatogenous retinal detachments are associated with proliferative retinopathy—a retinopathy associated with diabetic neovascularization (see Chapter 31).

Tension, or a pulling force, is responsible for *traction retinal detachment*. An ophthalmologist must ascertain all of the areas of retinal break and identify and release the scars or bands of fibrous material providing traction on the retina. In general, patients with this condition have developed fibrous scar tissue from conditions such as diabetic retinopathy, vitreous hemorrhage, or the retinopathy of prematurity. The hemorrhages and fibrous proliferation associated with these conditions exert a pulling force on the delicate retina.

Patients can have both rhegmatogenous and traction retinal detachment. *Exudative retinal detachments* are the result of the production of a serous fluid under the retina from the choroid. Conditions such as uveitis and macular degeneration may cause the production of this serous fluid.

Clinical Manifestations

Patients may report the sensation of a shade or curtain coming across the vision of one eye, cobwebs, bright flashing lights, or the sudden onset of a great number of floaters. Patients do not complain of pain but retinal detachment is an ocular emergency, requiring immediate surgical intervention for optimal outcomes.

Assessment and Diagnostic Findings

After visual acuity is determined, the patient must have a dilated fundus examination using an indirect ophthalmoscope as well as slit-lamp biomicroscopy. Stereo fundus photography and fluorescein angiography are commonly used during the evaluation.

Increasingly, optical coherence tomography and ultrasound are used for the complete retinal assessment, especially if the view is obscured by a dense cataract or vitreal hemorrhage. All retinal breaks, all fibrous bands that may be causing traction on the retina, and all degenerative changes must be identified.

Surgical Management

In rhegmatogenous detachment, an attempt is made to surgically reattach the sensory retina to the RPE. In traction retinal detachment, the source of traction must be removed and the sensory retina reattached. The most commonly used surgical interventions are the scleral buckle and vitrectomy (Boyd, 2016).

Scleral Buckle

The retinal surgeon compresses the sclera (often with a scleral buckle [see Fig. 42-12] or a silicone band) to indent the scleral wall from the outside of the eye and bring the two retinal layers in contact with each other (Boyd, 2016).

Vitrectomy

A vitrectomy is an intraocular procedure that allows the introduction of a light source through an incision; a second incision serves as the portal for the vitrectomy instrument. The surgeon dissects preretinal membranes under direct visualization while the retina is stabilized by an intraoperative vitreous substitute.

Traction on the retina may be relieved through vitrectomy and may be combined with scleral buckling to repair retinal detachments. A gas bubble, silicone oil, or perfluorocarbon and liquids may be injected into the vitreous cavity to help push the sensory retina up against the RPE. Argon laser photocoagulation or cryotherapy is also used to hold the retina in place (Boyd, 2016).

Nursing Management

Nursing management consists of educating the patient and providing supportive care. Postoperative positioning of the patient is critical when a gas bubble is used because the injected bubble must remain in position overlying the area of detachment, providing consistent pressure to reattach the sensory retina. The patient must maintain a prone position that would allow the gas bubble to act as a tamponade for the retinal break (Boyd, 2016). Patients and family members should be made aware of these needs beforehand so that the patient can be made as comfortable as possible.

In most cases, vitreoretinal procedures are performed on an outpatient basis, and the patient is seen the next day for a follow-up examination. Postoperative complications may

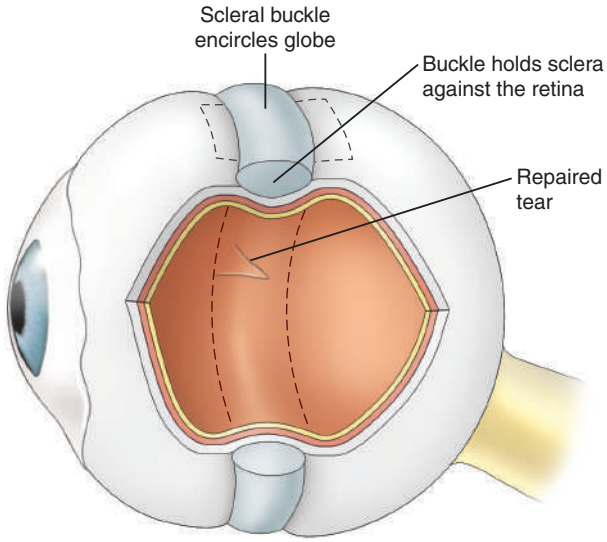


Figure 42-12 • Scleral buckle.

include increased IOP, endophthalmitis, retinal detachment, and development of cataracts. Patients must be educated about the signs and symptoms of complications, particularly of increasing IOP and postoperative infection. Contact details for the ophthalmic team are provided and the patient is encouraged to call immediately if complications occur.

Retinal Vascular Disorders

Loss of vision can occur from occlusion of a retinal artery or vein. Such occlusions may result from atherosclerosis, valvular heart disease, venous stasis, hypertension, or increased blood viscosity. Associated risk factors include diabetes, glaucoma, and aging.

Central Retinal Vein Occlusion

Blood supply to and from the ocular fundus is provided by the central retinal artery and vein. Central retinal vein occlusions (CRVOs) are found most often in people older than 50 years. Patients who suffer a CRVO report decreased visual acuity ranging from mild blurring to severely limited.

Direct ophthalmoscopy of the retina shows optic disc swelling, venous dilation and tortuousness, retinal hemorrhages, cotton-wool spots, and a bloody appearance of the retina. The better the initial visual acuity, the better the general prognosis.

Fluorescein angiography may show extensive areas of capillary closure. The patient should be monitored carefully over the ensuing several months for signs of neovascularization and neovascular glaucoma. Laser panretinal photocoagulation may be necessary to treat the abnormal neovascularization. Neovascularization of the iris may cause neovascular glaucoma. Macular edema, macular nonperfusion, and vitreous hemorrhage from the neovascularization are among the potential complications of CRVO.

Branch Retinal Vein Occlusion

Some patients with branch retinal vein occlusion (BRVO) are symptom free, whereas others complain of a sudden loss of vision if the macular area is involved. A more gradual loss of vision may occur if macular edema associated with BRVO develops.

On examination, the ocular fundus appears similar to that found in CRVO. The occlusions generally occur at the arteriovenous crossings. The diagnostic evaluation and follow-up assessments and complications are the same as for CRVO. Associated conditions include glaucoma, systemic hypertension, diabetes, and hyperlipidemia.

Central Retinal Artery Occlusion

Patients with central retinal artery occlusion, a relatively rare disorder that accounts for approximately 1 in 10,000 ophthalmologic visits, present with a sudden loss of vision. Visual acuity is reduced to being able to count the examiner's fingers, or the field of vision is tremendously restricted. A relative afferent pupillary defect is present. Examination of the ocular fundus reveals a pale retina with a cherry-red spot at the fovea. The retinal arteries are thin, and emboli are occasionally seen in the central retinal artery or its branches. Central retinal artery occlusion is a true ocular emergency. Various treatments are used: ocular massage, anterior chamber paracentesis, IV administration of hyperosmotic agents such as acetazolamide (Diamox), and high concentrations of oxygen. An aggressive stepwise approach may be beneficial, depending on the underlying cause of the occlusion and the amount of time from onset of occlusion to treatment. Most visual loss associated with central retinal artery occlusion is severe and permanent.

Age-Related Macular Degeneration

AMD accounts for 54% of all blindness in older adults (Centers for Disease Control [CDC], 2016). AMD is characterized by tiny, yellowish spots called *drusen* beneath the retina (see Fig. 42-13). Most people older than 60 years have at least a few small drusen, which are clusters of debris or waste material. When drusen are located in the macular area, they can affect vision. Patients with AMD have a wide range of visual loss, but only a small portion experience total blindness. Central vision is generally the most affected, with most patients retaining peripheral vision (see Fig. 42-14). There are two types of AMD: the dry type and the wet type (CDC, 2016).

Between 85% and 90% of people with AMD have the dry (nonneovascular, nonexudative) type of the condition, in which the outer layers of the retina slowly break down. With this breakdown comes the appearance of drusen. When the drusen occur outside of the macular area, patients generally have no symptoms. When the drusen occur within the macula, however, there is a gradual blurring of vision that patients may notice when they try to read.

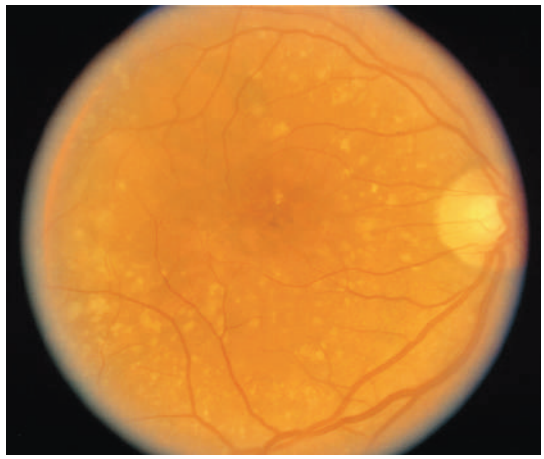


Figure 42-13 • Retina showing drusen and age-related macular degeneration.

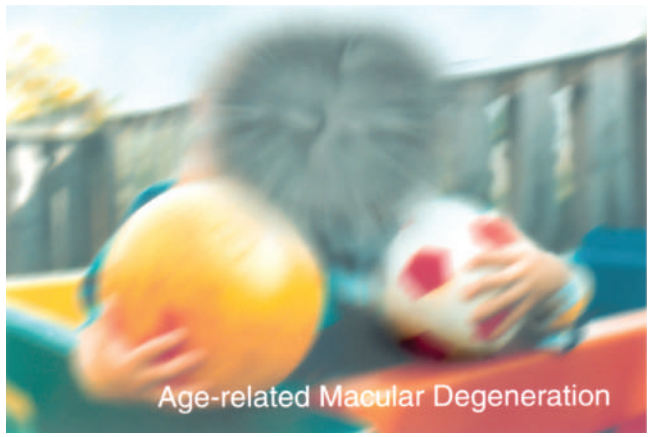


Figure 42-14 • Visual changes resulting from age-related macular degeneration. Photo courtesy of the National Eye Institute, National Institutes of Health.

The second type of AMD, the wet (neovascular, exudative) type, may have an abrupt onset and is more damaging to the vision (CDC, 2016). Patients report that straight lines appear crooked and distorted or that letters in words appear broken. This effect results from proliferation of abnormal blood vessels growing under the retina, within the choroid layer of the eye, a condition known as choroidal neovascularization. The affected vessels can leak fluid and blood, elevating the retina. Some patients can be treated with laser therapy to stop leakage from these vessels.

Medical Management

There is no known effective therapy for the dry (nonneovascular, nonexudative) type of AMD (Grossman & Porth, 2014).

An important component of treatment of wet (neovascular, exudative) AMD targets development and progression of angiogenesis (abnormal blood vessel formation). Vasoproliferation in wet AMD is believed to be caused by an underlying angiogenic stimulus known as vascular endothelial growth factor (VEGF) (Grossman & Porth, 2014). Examples of VEGF inhibitors given by intravitreal injection include ranibizumab (Lucentis) and bevacizumab (Avastin) (Comerford, 2015); (Grossman & Porth, 2014).

Nursing Management

Amsler grids are given to patients to use in their homes to monitor for a sudden onset or distortion of vision. These may provide the earliest sign that macular degeneration is getting worse. Patients should be encouraged to look at these grids, one eye at a time, several times each week with glasses on if needed for corrected near vision. If there is a change in the way the grid appears to the patient (e.g., if the lines or squares appear distorted or faded), the patient should notify the ophthalmologist immediately and should arrange to be seen promptly.

Orbital and Ocular Trauma

Whether affecting the eye or the orbit, trauma to the eye and surrounding structures may have devastating consequences for vision. It is preferable to prevent injury rather than treat it. Chart 42-10 details measures to prevent eye injuries.

Orbital Trauma

Injury to the orbit is usually associated with a head injury; hence, the patient's general medical condition must first be stabilized before conducting an ocular examination (Hickey, 2014). Only then is the globe assessed for soft tissue injury. During inspection, the face is meticulously assessed for underlying fractures, which should always be suspected in cases of blunt trauma. To establish the extent of ocular injury, visual acuity is assessed as soon as possible, even if it is only a rough estimate. Soft tissue orbital injuries often result in damage to the optic nerve. Major ocular injuries indicated by a soft globe, prolapsing tissue, ruptured globe, and hemorrhage require immediate surgical attention.

Chart 42-10 PATIENT EDUCATION

Education for Patients About Preventing Eye Injuries

The nurse instructs the patient in the following measures to prevent eye injuries:

In and Around the House

- Make sure that all spray nozzles are directed away from yourself before pressing down on the handle.
- Read instructions carefully before using cleaning fluids, detergents, ammonia, or harsh chemicals, and wash hands thoroughly after use.
- Use grease shields on frying pans to decrease spattering.
- Use opaque goggles to avoid burns from sunlamps.
- Wear special goggles to shield the eyes from fumes and splashes when using powerful chemicals.

In the Workshop

- Protect the eyes from flying fragments, fumes, dust particles, sparks, and splashed chemicals by wearing safety glasses.
- Read instructions thoroughly before using tools and chemicals, and follow precautions for their use.

Around Children

- Educate children about the correct way to handle potentially dangerous items, such as scissors and pencils.
- Pay attention to age and maturity level of a child when selecting toys and games, and avoid projectile toys, such as darts and pellet guns.
- Supervise children when they are playing with toys or games that can be dangerous.

In the Garden

- Avoid letting anyone stand at the side of or in front of a moving lawn mower.
- Avoid low-hanging branches.
- Direct pesticide spray can nozzles away from the face.
- Pick up rocks and stones before going over them with the lawn mower (stones can be hurled out of the rotary blades and rebound off curbs or walls, causing severe injury to the eye).

Around the Car

- Put out all smoking materials and matches before opening the hood of the car.
- Take standard safety precautions when using jumper cables (wear goggles; make sure the cars are not touching one another; make sure the jumper cable clamps never touch each other; never lean over the battery when attaching cables; and never attach a cable to the negative terminal of a dead battery).
- Use a flashlight, not a match or lighter, to look at the battery at night.
- Wear goggles when grinding metal or striking metal against metal while performing auto body repair.

In Sports

- Wear protective caps, helmets, or face protectors when appropriate, especially for sports such as ice hockey.
- Wear protective safety glasses, especially for sports such as racquetball, squash, tennis, baseball, and basketball.

Around Fireworks

- Avoid explosive fireworks.
- Avoid standing near others when lighting fireworks.
- Douse firework duds in water instead of attempting to relight them.
- Never allow children to ignite fireworks.
- Wear eyeglasses or safety goggles.

Soft Tissue Injury and Hemorrhage

The signs and symptoms of soft tissue injury from blunt or penetrating trauma include tenderness, ecchymosis, lid swelling, proptosis or exophthalmos (abnormal protrusion of the eyeball), and hemorrhage. Closed injuries lead to contusions with subconjunctival hemorrhage, commonly known as a black eye. Blood accumulates in the tissues of the conjunctiva. Hemorrhage may be caused by a soft tissue injury to the eyelid or by an underlying fracture.

Management of soft tissue hemorrhage that does not threaten vision is usually conservative and consists of thorough inspection, cleansing, and repair of wounds. Cold compresses are used in the early phase, followed by warm compresses. Hematomas that appear as swollen, fluctuating areas may be surgically drained or aspirated; if they are causing significant orbital pressure, they may be surgically evacuated.

Orbital Fractures

Orbital fractures are detected by facial x-rays. Depending on the orbital structures involved, orbital fractures can be classified as blowout, zygomatic or tripod, maxillary, midfacial, orbital apex, and orbital roof fractures. Blowout fractures result from compression of soft tissue and the sudden increase in orbital pressure when the force is transmitted to the orbital floor, which is the area of least resistance (Hickey, 2014).

The inferior rectus and inferior oblique muscles, with their fat and fascial attachments, or the nerve that courses along the inferior oblique muscle may become entrapped, and the globe may be displaced inward (i.e., enophthalmos). Computed tomography (CT) scanning can identify the muscle and its auxiliary structures that are entrapped. These fractures are usually caused by the blunt force from a fist or baseball (Hickey, 2014).

Orbital roof fractures are dangerous because of potential complications to the brain. Surgical management of these fractures requires a neurosurgeon and an ophthalmologist. The most common indications for surgical intervention are displacement of bone fragments disfiguring the normal facial contours, interference with normal binocular vision caused by extraocular muscle entrapment, interference with mastication in zygomatic fracture, and obstruction of the nasolacrimal duct. Surgery is usually nonemergent, and a period of 10 to 14 days gives the ophthalmologist time to assess ocular function, especially the extraocular muscles and the nasolacrimal duct. Emergency surgical repair is usually not performed unless the globe is displaced into the maxillary sinus. Surgical repair is primarily directed at freeing the entrapped ocular structures and restoring the integrity of the orbital floor.

Foreign Bodies

Foreign bodies that enter the orbit are usually tolerated, except for copper, iron, and vegetable materials such as those from plants or trees, which may cause purulent infection. X-rays and CT scans are used to identify the foreign body. A careful history is important, especially if the foreign body has been in the orbit for a period of time and the incident forgotten. It is important to identify metallic foreign bodies because they prohibit the use of magnetic resonance imaging (MRI) as a diagnostic tool.

After the extent of the orbital damage is assessed, the decision to use conservative treatment or surgical removal is made. In general, orbital foreign bodies are removed if they are superficial and anterior in location; have sharp edges that may affect adjacent orbital structures; or are composed of copper, iron, or vegetable material. Surgical intervention is directed at preventing further ocular injury and maintaining the integrity of the affected areas. Cultures are usually obtained, and the patient is placed on prophylactic IV antibiotic medications that are later changed to an oral route.

Ocular Trauma

Ocular trauma is a leading cause of blindness among children and young adults, especially male trauma victims. Ocular trauma occurs with occupational injuries (e.g., construction industry), contact sports, weapons (e.g., air guns, BB guns), assaults, motor vehicle crashes (e.g., broken windshields), and explosions (e.g., blast fragments).

There are two types of ocular trauma in which the first response is critical: chemical burn and foreign object in the eye. With a chemical burn, the eye should be immediately irrigated with tap water or normal saline. With a foreign body, no attempt should be made to remove the foreign object. The object should be protected from jarring or movement to prevent further ocular damage. No pressure or patch should be applied to the affected eye. All other traumatic eye injuries should be protected using a patch or shield if available or a stiff paper cup until medical treatment can be obtained (see Fig. 42-15).

Assessment and Diagnostic Findings

A thorough history is obtained, particularly assessing the patient's ocular history, such as pre-injury vision in the affected eye or past ocular surgery. Details related to the injury that help in the diagnosis and assessment of the need for further tests include the nature of the ocular injury (i.e., blunt or penetrating trauma); the type of activity that caused the injury to determine the nature of the force striking the eye; and whether onset of vision loss was sudden, slow, or progressive. For chemical eye burns, the chemical agent must be identified and tested for pH if the agent is available. The corneal surface is examined for foreign bodies, wounds, and abrasions, after which the other external structures of the eye are examined. Pupil size, shape, and light reaction of the pupil of the affected eye are compared with the other eye. Ocular motility (ability of the eyes to move synchronously up, down, right, and left) is also assessed.

Medical Management

Splash Injuries

Splash injuries are irrigated with normal saline solution before further evaluation occurs. In cases of a ruptured globe,

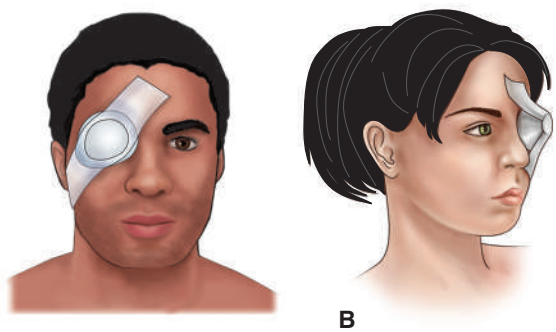


Figure 42-15 • Two kinds of eye patches. **A.** Aluminum shield. **B.** Stiff paper cup shield (innovative substitute when aluminum shield is unavailable).

cycloplegic agents (agents that paralyze the ciliary muscle) or topical antibiotics must be deferred because of potential toxicity to exposed intraocular tissues. Further manipulation of the eye must be avoided until the patient is under general anesthesia. Parenteral, broad-spectrum antibiotics are initiated. Tetanus antitoxin is given, if indicated, as well as analgesic agents. (Tetanus prophylaxis is recommended for full-thickness ocular and skin wounds.) Any topical ophthalmic medication (e.g., anesthetic, dyes) must be sterile.

Foreign Bodies and Corneal Abrasions

After removal of a foreign body from the surface of the eye, an antibiotic ointment is applied and the eye is patched. The eye is examined daily for evidence of infection until the wound is completely healed.

Contact lens wear is a common cause of corneal abrasion. The patient experiences severe pain and photophobia (ocular pain on exposure to light). Corneal epithelial defects are treated with antibiotic ointment and, in some instances, a pressure patch to immobilize the eyelids. Topical anesthetic eye drops must not be given to the patient to take home for repeated use after corneal injury because their effects mask further damage, delay healing, and can lead to corneal scarring.

Penetrating Injuries and Contusions of the Eyeball

Sharp penetrating injury or blunt contusion force can rupture the eyeball. When the globe, cornea, and sclera rupture, rapid decompression or herniation of the orbital contents into adjacent sinuses can occur. Blunt traumatic injuries (with an increased incidence of retinal detachment, intraocular tissue avulsion, and herniation) have a worse prognosis than penetrating injuries. Most penetrating injuries result in marked loss of vision with the following signs: hemorrhagic chemosis (edema of the conjunctiva), conjunctival laceration, shallow anterior chamber with or without an eccentrically placed pupil, hyphema (blood within the anterior chamber), or vitreous hemorrhage.

Hyphema is caused by contusion forces that tear the vessels of the iris and damage the anterior chamber angle. Preventing rebleeding and prolonged increased IOP are the goals of treatment for hyphema. In severe cases, the patient is hospitalized with moderate activity restriction. An eye shield is applied. Topical corticosteroids are prescribed to reduce inflammation. An antifibrinolytic agent (aminocaproic acid [Amicar]) stabilizes clot formation at the site of hemorrhage. Aspirin is contraindicated. A ruptured globe and severe injuries with intraocular hemorrhage require surgical intervention. Vitrectomy is performed for traumatic retinal detachments (Boyd, 2016). Primary enucleation (complete removal of the eyeball and part of the optic nerve) is considered only if the globe is irreparable and has no light perception. It is a general rule that enucleation is performed within 2 weeks of the initial injury (in an eye that has no useful vision after sustaining penetrating injury) to prevent the risk of sympathetic ophthalmia (an inflammation created in the uninjured eye by the affected eye that can result in blindness of the uninjured eye).

Intraocular Foreign Bodies

A patient who complains of blurred vision and discomfort should be questioned carefully about recent injuries and exposures. Patients may be injured in a number of different situations and experience an intraocular foreign body (IOFB). Precipitating circumstances can include working in construction, striking metal against metal, being involved in a motor vehicle crash with facial injury, a gunshot wound, grinding-wheel work, and explosions.

IOFB is diagnosed and localized by slit-lamp biomicroscopy and indirect ophthalmoscopy, as well as CT or ultrasonography scanning. MRI is contraindicated because most foreign bodies are metallic and magnetic. It is important to determine the composition, size, and location of the IOFB and affected eye structures. Every effort should be made to identify the type of IOFB and whether it is magnetic. Iron, steel, copper, and vegetable matter may cause intense inflammatory reactions. The incidence of endophthalmitis is high. Surgical excision of the foreign body depends on its location and composition and associated ocular injuries. Specially designed IOFB forceps and magnets are used to grasp and remove the foreign body. Any damaged area of the retina is treated to prevent retinal detachment.

Ocular Burns

Alkali, acid, and other chemically active organic substances, such as Mace and tear gas, cause chemical burns. Alkali burns (e.g., lye, ammonia) result in the most severe injury because they penetrate the ocular tissues rapidly and continue to cause long-term damage. Increased IOP also occurs. Acids (e.g., bleach, car batteries, refrigerant) generally cause less damage because the precipitated necrotic tissue proteins form a barrier to further penetration and damage. Chemical burns may appear as superficial punctate keratopathy (i.e., spotty damage to the cornea), subconjunctival hemorrhage, or complete marbleizing of the cornea.

In treating chemical burns, every minute counts. Immediate irrigation with tap water should be started on site before transport of the patient to an emergency department. A brief history and examination are performed. Critical information, if available, is the name of the substance that went into the eye (the actual container is best). Material safety data sheets (MSDS) should be accessed for reference (see Chapter 61). The corneal surfaces and conjunctival fornices are immediately and copiously irrigated with normal saline or any neutral solution. A local anesthetic is instilled, and a lid speculum is applied to overcome blepharospasm (i.e., spasms of the eyelid muscles that result in closure of the lids). Particulate matter must be removed from the fornices using moistened, cotton-tipped applicators and minimal pressure on the globe. Irrigation continues until the conjunctival pH normalizes (between 7.3 and 7.6). The pH of the corneal surface is checked by placing a pH paper strip in the fornix. Antibiotic agents are instilled, and the eye usually is patched.

The goal of intermediate treatment is to prevent tissue ulceration and promote re-epithelialization of the cornea. Intense lubrication using artificial tears without preservatives (to avoid allergic reactions) is essential. Patching or therapeutic soft lenses may also be used to promote corneal healing, and the patient is closely monitored. Prognosis depends on the type of injury and adequacy of the irrigation immediately after exposure. Long-term treatment consists of two phases: restoration of the ocular surface through grafting procedures and surgical restoration of corneal integrity and optical clarity.

Thermal injury is caused by exposure to a hot object (e.g., curling iron, tobacco, ash), whereas photochemical injury results from ultraviolet irradiation or infrared exposure (e.g., exposure to the reflections from snow, sun gazing, viewing an eclipse of the sun without an adequate filter). These injuries can cause corneal epithelial defect, corneal opacity, conjunctival chemosis and injection (congestion of blood vessels), and burns

of the eyelids and periocular region. Antibiotic agents and a patch for 24 hours constitute the treatment of mild injuries.

INFECTIOUS AND INFLAMMATORY CONDITIONS

Inflammation and infections of eye structures are common. Table 42-7 summarizes selected common infections and their treatment.

Dry Eyes

Dry eyes can be caused by decreased tear production or increased tear evaporation, which can be episodic or chronic (Grossman & Porth, 2014). Decreased tear production (aqueous deficiency) can be caused by systemic disease (Sjögren syndrome, connective tissue disease), lacrimal gland obstruction, and systemic drugs (e.g., diuretics, antihistamines, psychotropic drugs). Increased tear evaporation (evaporative dry eye) can be caused by meibomian gland deficiency, lid aperture disorder, vitamin A deficiency, reduced lid blinking rate, preservatives from topical drugs, ocular surface disease (allergy), and contact lens wear. Risk factors include increasing age, smoking, recent refractive surgery, and postmenopausal status (in women). An increase in the intake of omega-3 fatty acids may be beneficial in reducing the risk (Grossman & Porth, 2014).

Clinical Manifestations

The most common complaints are photophobia, foreign-body sensation, burning and stinging, redness, and decreased tearing.

Assessment and Diagnostic Findings

Chronic dry eyes may result in chronic conjunctival and corneal irritation that can lead to corneal erosion, scarring, ulceration, thinning, or perforation that can seriously threaten vision. Secondary bacterial infection can occur.

Management

Management of dry eyes requires the cooperation of the patient with a regimen that needs to be followed at home for a long period; otherwise, complete relief of symptoms is unlikely. Instillation of artificial tears during the day and an ointment at night is the usual regimen to hydrate and lubricate the eye and preserve a moist ocular surface. Cyclosporine ophthalmic emulsion (Restasis) is an effective agent that increases tear production and is used once daily. Anti-inflammatory medications are also used, and moisture chambers (e.g., moisture chamber spectacles, swim goggles) may provide additional relief.

Patients may become hypersensitive to chemical preservatives such as benzalkonium chloride and thimerosal. For these patients, preservative-free ophthalmic solutions are used. Management of dry eyes also includes the concurrent treatment of infections, such as chronic blepharitis and acne rosacea, and treating the underlying systemic disease, such as Sjögren syndrome (an autoimmune disease).

Surgical treatment includes punctal occlusion, grafting procedures, and lateral tarsorrhaphy (uniting the edges of the lids). Punctal plugs are made of silicone material for the temporary or permanent occlusion of the puncta. These help to preserve the volume of natural tears and prolong the effects of artificial tears (Grossman & Porth, 2014).

Conjunctivitis

Conjunctivitis (inflammation of the conjunctiva) is a common ocular disorder worldwide. It is characterized by a pink appearance (hence the common term *pink eye*) because of subconjunctival blood vessel congestion.

Clinical Manifestations

General symptoms include foreign-body sensation, scratching or burning sensation, itching, and photophobia. Conjunctivitis

TABLE 42-7 Common Infections and Inflammatory Disorders of Eye Structures

Disorder	Description	Management
Hordeolum (stye)	Acute suppurative infection of the glands of the eyelids caused by *Staphylococcus aureus.* The lid is red and edematous with a small collection of pus in the form of an abscess. There is considerable discomfort.	Warm compresses are applied directly to the affected lid area 3–4 times a day for 10–15 minutes. If the condition is not improved after 48 hours, incision and drainage may be indicated. Application of topical antibiotics may be prescribed thereafter.
Chalazion	Sterile inflammatory process involving chronic granulomatous inflammation of the meibomian glands; can appear as a single granuloma or multiple granulomas in the upper or lower eyelids.	Warm compresses applied 3–4 times a day for 10–15 minutes may resolve the inflammation in the early stages. Most often, however, surgical excision is indicated. Corticosteroid injection to the chalazion lesion may be used for smaller lesions.
Blepharitis	Chronic bilateral inflammation of the eyelid margins. There are 2 types: staphylococcal and seborrheic. Staphylococcal blepharitis is usually ulcerative and is more serious due to the involvement of the base of hair follicles. Permanent scarring can result.	The seborrheic type is chronic and is usually resistant to treatment, but the milder cases may respond to lid hygiene. Staphylococcal blepharitis requires topical antibiotic treatment. Instructions on lid hygiene (to keep the lid margins clean and free of exudates) are given to the patient.
Bacterial keratitis	Infection of the cornea by *S. aureus, Streptococcus pneumoniae,* and *Pseudomonas aeruginosa.*	Fortified (high-concentration) antibiotic eye drops are given every 30 minutes around the clock for the first few days, then every 1–2 hours. Systemic antibiotics may be given. Cycloplegics are given to reduce pain caused by ciliary spasm. Corticosteroid therapy and subconjunctival injections of antibiotics are controversial.
Herpes simplex keratitis	Symptoms are severe pain, tearing, and photophobia. The dendritic ulcer has a branching, linear pattern with feathery edges and terminal bulbs at its ends. Herpes simplex keratitis can lead to recurrent stromal keratitis and persist to 12 months with residual corneal scarring.	Many lesions heal without treatment and residual effects. The treatment goal is to minimize the damaging effect of the inflammatory response and eliminate viral replication within the cornea. Penetrating keratoplasty is indicated for corneal scarring and must be performed when the herpetic disease has been inactive for many months.

may be unilateral or bilateral, but the infection usually starts in one eye and then spreads to the other eye by hand contact.

Assessment and Diagnostic Findings

The four main clinical features important to evaluate are the type of discharge (watery, mucoid, purulent, or mucopurulent), type of conjunctival reaction (follicular or papillary), presence of pseudomembranes or true membranes, and presence or absence of lymphadenopathy (enlargement of the preauricular and submandibular lymph nodes where the eyelids drain). Pseudomembranes consist of coagulated exudate that adheres to the surface of the inflamed conjunctiva. True membranes form when the exudate adheres to the superficial layer of the conjunctiva, and removal results in bleeding. Follicles are multiple, slightly elevated lesions encircled by tiny blood vessels; they look like grains of rice. Papillae are hyperplastic conjunctival epithelium in numerous projections that are usually seen as a fine mosaic pattern under slit-lamp examination. Diagnosis is based on the distinctive characteristics of ocular signs, acute or chronic presentation, and identification of any precipitating events. Positive results of swab smear preparations and cultures confirm the diagnosis.

Types of Conjunctivitis

Conjunctivitis is classified according to its cause. The major causes are microbial infection, allergy, and irritating toxic stimuli. A wide spectrum of organisms can cause conjunctivitis, including bacteria (e.g., *Chlamydia*), viruses, fungus, and parasites. Conjunctivitis can also result from an existing ocular infection or can be a manifestation of a systemic disease.

Microbial Conjunctivitis

Bacterial Conjunctivitis

Bacterial conjunctivitis can be acute or chronic. The acute type can develop into a chronic condition. Signs and symptoms can vary from mild to severe. Chronic bacterial conjunctivitis is usually seen in patients with lacrimal duct obstruction, chronic dacryocystitis, and chronic blepharitis. The most common causative microorganisms are *Streptococcus pneumoniae, Haemophilus influenzae,* and *Staphylococcus aureus.*

Bacterial conjunctivitis manifests with an acute onset of redness, burning, and discharge. There is papillary formation, conjunctival irritation, and injection in the fornices. The exudates are variable but are usually present on waking in the morning. The eyes may be difficult to open because of adhesions caused by the exudate. Purulent discharge occurs in severe acute bacterial infections, whereas mucopurulent discharge appears in mild cases. In gonococcal conjunctivitis, the symptoms are more acute. The exudate is profuse and purulent, and there is lymphadenopathy. Pseudomembranes may be present.

Trachoma is an infectious disease caused by the bacterium *Chlamydia trachomatis,* an ancient disease and the leading cause of preventable blindness in the world (Grossman & Porth, 2014). It is prevalent in areas with hot, dry, and dusty climates and in areas with poor living conditions. It is spread by direct contact or by carrier (e.g., insects such as flies and gnats). The onset of trachoma in children is usually insidious, but it can be acute or subacute in adults. The initial symptoms include red inflamed eyes, tearing, photophobia, ocular pain, purulent exudates, preauricular lymphadenopathy, and lid edema. Initial ocular signs include follicular and papillary formations. At the middle stage of the disease, there is an acute inflammation with papillary hypertrophy and follicular necrosis, after which trichiasis and entropion begin to develop. The lashes that are turned in rub against the cornea and, after prolonged irritation, cause corneal erosion and ulceration. The late stage of the disease is characterized by scarred conjunctiva, subepithelial keratitis, abnormal vascularization of the cornea (pannus), and residual scars from the follicles that look like depressions in the conjunctiva (Herbert pits). Severe corneal ulceration can lead to perforation and blindness.

Inclusion conjunctivitis affects sexually active people who have genital chlamydial infection. Transmission is by oral–genital sex or hand-to-eye transmission. Indirect transmission can occur in inadequately chlorinated swimming pools. The eye lesions usually appear a week after exposure and may be associated with a nonspecific urethritis or cervicitis. The discharge is mucopurulent, follicles are present, and there is lymphadenopathy.

Viral Conjunctivitis

Viral conjunctivitis can be acute and chronic. The discharge is watery, and follicles are prominent. Severe cases include pseudomembranes. The common causative organisms are adenovirus and herpes simplex virus. Conjunctivitis caused by adenovirus is highly contagious. The condition is usually preceded by symptoms of upper respiratory infection. Corneal involvement causes extreme photophobia. Symptoms include tearing, redness, and foreign-body sensation that can involve one or both eyes. There is lid edema, ptosis, and conjunctival hyperemia (red eyes caused by dilation of blood vessels) (see Fig. 42-16). These signs and symptoms vary from mild to severe. Viral conjunctivitis, although self-limited, tends to last longer than bacterial conjunctivitis.

Epidemic keratoconjunctivitis (EKC) is a highly contagious viral conjunctivitis that is easily transmitted from one person to another among household members, schoolchildren, and health care workers. The outbreak of epidemics is seasonal, especially during the summer when people use swimming pools. EKC is most often accompanied by preauricular lymphadenopathy and occasionally periorbital pain. There are marked follicular and papillary formations. This type of conjunctivitis can lead to keratopathy.

Allergic Conjunctivitis

Immunologic or allergic conjunctivitis is a hypersensitivity reaction that occurs as part of allergic rhinitis (hay fever), or it can be an independent allergic reaction. The patient usually has a

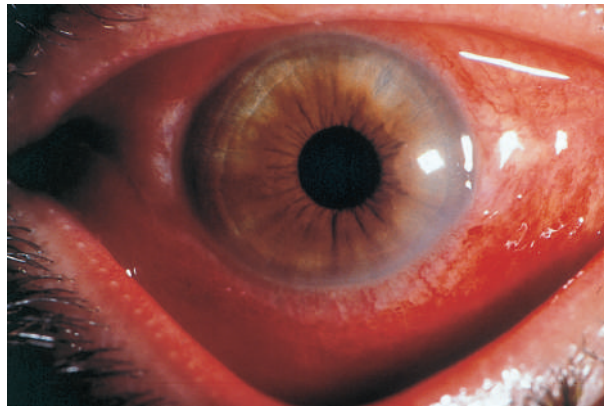


Figure 42-16 • Conjunctival hyperemia in viral conjunctivitis.

history of an allergy to pollens and other environmental allergens. There is extreme pruritus, epiphora (excessive secretion of tears), injection, and usually severe photophobia. The stringlike mucoid discharge is usually associated with rubbing the eyes because of severe pruritus. Vernal conjunctivitis is also known as seasonal conjunctivitis because it appears mostly during warm weather. There may be large formations of papillae that have a cobblestone appearance. It is more common in children and young adults. Most affected people have a history of asthma or eczema.

Toxic Conjunctivitis

Chemical conjunctivitis can be the result of medications; chlorine from swimming pools; exposure to toxic fumes among industrial workers; or exposure to other irritants such as smoke, hair sprays, acids, and alkalis.

Medical Management

The management of conjunctivitis depends on the type. Most types of mild and viral conjunctivitis are self-limiting, benign conditions that may not require treatment and laboratory procedures. For more severe cases, topical antibiotic agents, eye drops, or ointments are prescribed. Patients with gonococcal conjunctivitis require urgent antibiotic therapy. If left untreated, this ocular disease can lead to corneal perforation and blindness. The systemic complications can include meningitis and sepsis.

Bacterial Conjunctivitis

Acute bacterial conjunctivitis is almost always self-limiting, lasting 2 weeks if left untreated. If treated with antibiotics, it may last a few days, except for gonococcal and staphylococcal conjunctivitis.

For trachoma, usually broad-spectrum antibiotic agents are given topically and systemically. Surgical management includes the correction of trichiasis to prevent conjunctival scarring.

Adult inclusion conjunctivitis requires 1 week of antibiotics. Prevention of reinfection is important, and affected people and their sexual partners must seek treatment for sexually transmitted infection, if indicated.

Viral Conjunctivitis

Viral conjunctivitis is not responsive to any treatment. Cold compresses may alleviate some symptoms. Viral conjunctivitis, especially EKC, is highly contagious. Patients must be made aware of the contagious nature of the disease, and adequate education must be provided (see Chart 42-11).

Proper steps must be taken to avoid health care–associated infections. Frequent hand hygiene and procedures for environmental cleaning and disinfection of equipment used for eye examination must be strictly followed at all times. To prevent spread during outbreaks of conjunctivitis caused by adenovirus, health care facilities must set aside specified areas for treating patients diagnosed with or suspected of having conjunctivitis caused by adenovirus. All forms of tonometry must be avoided unless medically indicated. All multidose ophthalmic medications must be discarded at the end of each day or when contaminated. Employees who are infected and others must not be allowed to work or attend school until symptoms have resolved, which can take 3 to 7 days.

Allergic Conjunctivitis

Patients with allergic conjunctivitis, especially recurrent vernal or seasonal conjunctivitis, are usually given corticosteroids in ophthalmic preparations. Depending on the severity of the disease, they may be given oral preparations. The use of vasoconstrictors, such as topical epinephrine solution, cold compresses, ice packs, and cool ventilation usually provide comfort by decreasing swelling.

Chart 42-11 PATIENT EDUCATION

Education for Patients with Viral Conjunctivitis

Viral conjunctivitis is a highly contagious eye infection that can easily spread from one person to another. The symptoms can be alarming but are not serious.

The nurse instructs the patient about this eye condition and the following self-care strategies:

- Be aware that your eyes will look red and will have watery discharge, and your lids will be swollen for about a week.
- Expect to experience eye pain, a sandy sensation in your eye, and sensitivity to light.
- Keep in mind that symptoms will resolve after about 1 week.
- Use lightweight cold compresses over your eyes for about 10 minutes 4–5 times a day to soothe the pain.
- Use artificial tears for the sandy sensation in your eye and mild pain medications such as acetaminophen/paracetamol (Tylenol).
- Stay at home and not go outside. You may return to work or school after 7 days, when the redness and discharge have cleared. Obtain a note from your primary provider to return to work or school.
- Do not share towels, linens, makeup, or any items that have come in contact with your eyes.
- Wash your hands thoroughly with soap and water frequently, including before and after you apply artificial tears or cold compresses.
- Use a new tissue every time you wipe the discharge from your eye. Dampen the tissue with clean water to clean the outside of the eye.
- Wash your face and take a shower as you normally do.
- Discard all of your makeup articles and do not apply makeup until the infection has resolved.
- Wear dark glasses if bright lights bother you.
- Note if the discharge from your eye turns yellowish and purulent or if your vision changes and return to the primary provider for an examination.

Toxic Conjunctivitis

For conjunctivitis caused by chemical irritants, the eye must be irrigated immediately and profusely with saline or sterile water.

Uveitis

Inflammation of the uveal tract (uveitis) can affect the iris, the ciliary body, or the choroid. There are two types of uveitis: nongranulomatous and granulomatous.

The more common form of uveitis is the nongranulomatous type, which manifests as an acute condition with pain, photophobia, and a pattern of conjunctival injection, especially around the cornea. The pupil is small or irregular, and vision is blurred. There may be small, fine precipitates on the posterior corneal surface and cells in the aqueous humor (i.e., cell and flare). If the uveitis is severe, a hypopyon (accumulation of inflammatory cells in the anterior chamber of the eye) may develop. The condition may be unilateral or bilateral and may be recurrent. Repeated attacks of nongranulomatous anterior uveitis can cause anterior synechiae (peripheral iris adheres to the cornea and impedes outflow of aqueous humor). Posterior

synechiae (adherence of the iris and lens) block aqueous outflow from the posterior chamber. Secondary glaucoma can result from either anterior or posterior synechiae. Cataracts may also occur as a sequela to uveitis.

Granulomatous uveitis can have a more insidious onset and can involve any portion of the uveal tract. It tends to be chronic. Symptoms such as photophobia and pain may be minimal. Vision is markedly and adversely affected. Conjunctival injection is diffuse, and there may be vitreous clouding. In a severe posterior uveitis, such as chorioretinitis, there may be retinal and choroidal hemorrhages.

Medical Management

Because photophobia is a common symptom, patients should wear dark glasses outdoors. Ciliary spasm and synechia are best avoided through mydriasis; cyclopentolate (Cyclogyl) and atropine are commonly used. Local corticosteroid drops, such as Pred Forte 1% and Flarex 0.1%, instilled four to six times a day are also used to decrease inflammation.

If the uveitis is recurrent, a careful history should be initiated to discover any underlying causes. This evaluation should include a complete history, physical examination, and diagnostic tests, including a complete blood count, erythrocyte sedimentation rate, antinuclear antibodies, and Venereal Disease Research Laboratory (VDRL) and Lyme disease titers. Underlying causes include autoimmune disorders such as ankylosing spondylitis and sarcoidosis as well as toxoplasmosis, herpes zoster virus, ocular candidiasis, histoplasmosis, herpes simplex virus, tuberculosis, and syphilis.

Orbital Cellulitis

Orbital cellulitis is inflammation of the tissues surrounding the eye that may result from bacterial, fungal, or viral inflammatory conditions of contiguous structures, such as the face, oropharynx, dental structures, or intracranial structures. It can also result from foreign bodies and pre-existing ocular infection, such as dacryocystitis and panophthalmitis, or from sepsis. Infection of the sinuses is the most frequent cause. Infection originating in the sinuses can spread easily to the orbit through the thin bony walls and foramina or by means of the interconnecting venous system of the orbit and sinuses. The most common causative organisms are staphylococci and streptococci in adults. The symptoms include pain, eyelid swelling, conjunctival edema, proptosis, and decreased ocular motility. With such edema, optic nerve compression can occur and IOP may increase.

The severe intraorbital tension caused by abscess formation and the impairment of optic nerve function in orbital cellulitis can result in permanent visual loss. Because of the orbit's proximity to the brain, orbital cellulitis can lead to life-threatening complications, such as intracranial abscess and cavernous sinus thrombosis.

Medical Management

Immediate administration of high-dose, broad-spectrum, systemic antibiotics is indicated. Cultures and Gram-stained smears are obtained. Monitoring changes in visual acuity, degree of proptosis, central nervous system function (e.g., nausea, vomiting, fever, cognitive changes), displacement of the globe, extraocular movements, pupillary signs, and the fundus is extremely important. Consultation with an otolaryngologist is necessary, especially when rhinosinusitis is suspected. In the event of abscess formation or progressive loss of vision, surgical drainage of the abscess or sinus is performed. Sinusotomy and antibiotic irrigation are also performed.

ORBITAL AND OCULAR TUMORS

Benign Tumors of the Orbit

Benign tumors can develop from infancy and grow rapidly or slowly and present in later life. Some benign tumors are superficial and are easily identifiable by external presentation, palpation, and x-rays, but some are deep and may require a CT scan to diagnose. There can be significant proptosis, and visual function may be jeopardized. Benign tumors are masses characterized by the lack of infiltration in the surrounding tissues. Examples are cystic dermoid cysts and mucocele, hemangiomas, lymphangiomas, lacrimal tumors, and neurofibromas.

To prevent recurrence, benign masses are excised completely when possible. Excision may be difficult because of the involvement of some portions of the orbital bones, such as deep dermoid cysts, in which dissection of the bone is required. Subtotal resection may be indicated in deep benign tumors that intertwine with other orbital structures, such as optic nerve meningiomas. Complete removal of the tumor may endanger visual function.

Benign Tumors of the Eyelids

There are a wide variety of benign tumors that increase in frequency with age. Nevi may be unpigmented at birth and may enlarge and darken in adolescence or may never acquire any pigment at all. Hemangiomas are vascular capillary tumors that may be bright, superficial, red lesions (formerly known as strawberry angiomas) or bluish and purplish deeper lesions. Milia are small, white, slightly elevated cysts of the eyelid that may occur in multiples. Xanthelasma are yellowish, lipoid deposits on both lids that commonly appear as a result of the aging of the skin or a lipid disorder. Molluscum contagiosum lesions are flat, symmetric growths along the lid margin caused by a virus that can result in conjunctivitis and keratitis if the lesion grows into the conjunctival sac.

Treatment of benign congenital lid lesions is rarely indicated except when visual function is affected. Corticosteroid injection to the hemangioma lesion is usually effective, but surgical excision may be performed. Benign lid lesions usually present aesthetic problems rather than visual function problems. Surgical excision, or electrocautery, is primarily performed for cosmetic reasons, except for cases of molluscum contagiosum, for which surgical intervention is performed to prevent an infectious process that may ensue.

Benign Tumors of the Conjunctiva

Conjunctival nevus, a congenital benign neoplasm, is a flat, slightly elevated, brown spot that becomes pigmented during late childhood or adolescence. This should be differentiated from the pigmented lesion melanosis, which is acquired at middle age and may become melanoma. Keratin- and sebum-containing dermoid cysts are congenital and can be found

in the conjunctiva. Dermolipoma is a congenital tumor that manifests as a smooth, rounded growth in the conjunctiva near the lateral canthus. Papillomas are usually soft with irregular surfaces and appear on the lid margins. Treatment consists of surgical excision.

Malignant Tumors of the Orbit

Rhabdomyosarcoma is the most common malignant primary orbital tumor in childhood; it can also develop in older adults. The symptoms of rhabdomyosarcoma include sudden painless proptosis of one eye followed by lid swelling, conjunctival chemosis, and impairment of ocular motility. CT or MRI scans of these tumors establish the size, configuration, location, and stage of the disease; delineates the degree of bone destruction; and is useful in estimating the field for radiation therapy. The most common site of metastasis is the lung.

Management of these primary malignant orbital tumors involves three major therapeutic modalities: surgery, radiation therapy, and adjuvant chemotherapy. The degree of orbital destruction is important in planning the surgical approach. Resection often involves removal of the eyeball. The psychological needs of the patient and family are paramount in planning the management approach.

Malignant Tumors of the Eyelid

Basal cell carcinoma is the most common malignant tumor of the eyelid. Squamous cell carcinoma occurs less frequently but is considered the second most common malignant tumor. Melanoma is rare. Malignant eyelid tumors occur more frequently among people with a fair complexion who have a history of chronic exposure to the sun (Grossman & Porth, 2014).

Basal cell carcinoma appears as a painless nodule that may ulcerate. The lesion is invasive, spreads to the surrounding tissues, and grows slowly but does not metastasize. It usually appears on the lower lid margin near the inner canthus with a pearly white margin. Squamous cell carcinoma of the eyelids may resemble basal cell carcinoma initially because it also grows slowly and painlessly. It tends to ulcerate and invade the surrounding tissues, but it can metastasize to the regional lymph nodes. Melanoma may not be pigmented and can arise from nevi. It spreads to the surrounding tissues and metastasizes to other organs.

Complete excision of these carcinomas is followed by reconstruction with skin grafting if the surgical excision is extensive. The ocular postoperative site and the graft donor site are monitored for bleeding. Donor graft sites may include the buccal mucosa, the thigh, or the abdomen. The patient is referred to an oncologist for evaluation of the need for radiation therapy and monitoring for metastasis. Early diagnosis and surgical management are the basis of a good prognosis. These conditions have life-threatening consequences, and surgical excisions may result in facial disfigurement. Emotional support is an extremely important aspect of nursing management.

Malignant Tumors of the Conjunctiva

Conjunctival carcinoma most often grows in the exposed areas of the conjunctiva. The typical lesions are usually gelatinous and whitish due to keratin formation. They grow gradually, and deep invasion and metastasis are rare. Melanoma is rare but may arise from a pre-existing nevus or acquired melanosis during middle age. Squamous cell carcinoma is also rare but invasive.

The management is surgical incision. Some benign tumors and most malignant tumors recur. To avoid recurrences, patients usually undergo radiation therapy and cryotherapy after the excision of malignant tumors. Cosmetic disfigurement may result from extensive excision when deep invasion by the malignant tumor is involved.

Malignant Tumors of the Globe

Ocular melanoma is a rare malignant choroidal tumor sometimes discovered on a retinal examination. In its early stages, it could be mistaken for a nevus. In addition to a complete physical examination to discover any evidence of metastasis (to the liver, lung, and breast), retinal fundus photography, fluorescein angiography, and ultrasonography are performed. The diagnosis is confirmed at biopsy after enucleation.

Tumors are classified according to boundary lines (apical height and basal diameter) as small, medium, or large. Small tumors are generally monitored, whereas medium and large tumors require treatment. Treatment consists of radiation, enucleation, or both. Radiation therapy may be achieved by external beam performed in repeated episodes over several days or through the implantation of a small plaque that contains radioactive iodine (I-125) pellets over the tumor.

SURGICAL PROCEDURES AND ENUCLEATION

Orbital Surgeries

Orbital surgeries may be performed to repair fractures, remove a foreign body, or remove benign or malignant growths. Surgical procedures involving the orbit and lids affect facial appearance (cosmesis). The goals are to recover and preserve visual function and to maintain the anatomic relationship of the ocular structures to achieve cosmesis. During the repair of orbital fractures, the orbital bones are realigned to follow the anatomic positions of facial structures.

Orbital surgical procedures involve working around delicate structures of the eye, such as the optic nerve, retinal blood vessels, and ocular muscles. Complications of orbital surgical procedures may include blindness as a result of damage to the optic nerve and its blood supply. Sudden pain and loss of vision may indicate intraorbital hemorrhage or compression of the optic nerve. Ptosis and diplopia may result from trauma to the extraocular muscles during the surgical procedure, but these conditions typically resolve after a few weeks.

Prophylaxis with IV antibiotic agents is the usual postoperative regimen after orbital surgery, especially with repair of orbital fractures and intraorbital foreign-body removal. IV corticosteroids may be used if there is concern about optic nerve swelling. Topical ocular antibiotics are typically instilled, and antibiotic ointments are applied externally to the skin suture sites.

For the first 24 to 48 hours postoperatively, ice compresses are applied over the periocular area to decrease periorbital swelling, facial swelling, and hematoma. The head of the patient's bed should be elevated to a comfortable position (30 to 45 degrees).

Discharge education should include information about oral antibiotic agents, instillation of ophthalmic medications, and application of ocular compresses.

Enucleation

Enucleation is removal of the eyeball (globe) from the orbit, leaving the muscles and orbital contents intact. It may be surgically performed for the following conditions:

- Injury resulting in prolapse of uveal tissue or loss of light perception
- A blind, painful, deformed, or disfigured eye, usually caused by glaucoma, retinal detachment, or chronic inflammation
- An eye without useful vision that is producing or has produced sympathetic ophthalmia in the other eye
- Intraocular tumors that are untreatable by other means

The procedure for enucleation involves the separation and cutting of each of the ocular muscles and surrounding soft tissue and cutting of the optic nerve from the eyeball. The insertion of an orbital implant typically follows, and the conjunctiva is closed. A large pressure dressing is applied over the area.

Evisceration involves the removal of the intraocular contents through an incision or opening in the cornea or sclera. Evisceration may be surgically performed to treat severe ocular trauma with ruptured globe, severe ocular inflammation, or severe ocular infection. The optic nerve, sclera, extraocular muscles, and sometimes the cornea are left intact. The main advantage of evisceration over enucleation is that the final cosmetic result and motility after fitting the ocular prosthesis are enhanced.

Exenteration is the surgical removal of the entire contents of the orbit, surrounding soft tissue, and most or all of the eyelids. This surgery is indicated in malignancies of the orbit that are life threatening or when more conservative modalities of treatment have failed or are inappropriate. An example is squamous cell carcinoma of the paranasal sinuses, skin, and conjunctiva with deep orbital involvement. In its most extensive form, exenteration may include the removal of all orbital tissues and resection of the orbital bones.

Ocular Prostheses

Orbital implants and conformers (ocular prostheses usually made of silicone rubber) maintain the shape of the eye after enucleation or evisceration to prevent a contracted, sunken appearance. The temporary conformer is placed over the conjunctival closure after the implantation of an orbital implant. A conformer is placed after the enucleation or evisceration procedure to protect the suture line, maintain the fornices, prevent contracture of the socket in preparation for the ocular prosthesis, and promote the integrity of the eyelids.

All ocular prosthetics have limitations in their motility. There are two designs of eye prostheses. The anophthalmic ocular prostheses are used in the absence of the globe. Scleral shells look just like the anophthalmic prosthesis (see Fig. 42-17) but are thinner and fit over a globe with intact corneal sensation. An eye prosthesis usually lasts about 6 years, depending on the quality of fit, comfort, and cosmetic appearance. When the anophthalmic socket is completely healed, conformers are replaced with prosthetic eyes.

An ocularist is a specially trained and skilled professional who makes prosthetic eyes. After the ophthalmologist is satisfied that the anophthalmic socket is completely healed and is ready for prosthetic fitting, the patient is referred to an ocularist.

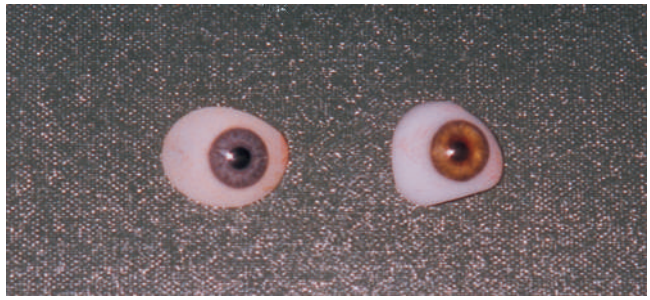


Figure 42-17 • Eye prostheses. (*Left*) Anophthalmic ocular prosthesis. (*Right*) Scleral shell.

The healing period is usually 6 to 8 weeks. It is advisable for the patient to have a consultation with the ocularist before the fitting. Obtaining accurate information and verbalizing concerns can lessen anxiety about wearing an ocular prosthesis.

Medical Management

Removal of an eye has physical, social, and psychological ramifications for any person. The significance of loss of the eye and vision must be addressed in the plan of care. The patient's preparation should include information about the surgical procedure and placement of orbital implants and conformers and the availability of ocular prosthetics to enhance cosmetic appearance. In some cases, patients may choose to see an ocularist before the surgery to discuss ocular prosthetics.

Nursing Management

Providing Education about Postsurgical and Prosthetic Care

Patients who undergo eye removal need to know that they will usually have a large ocular pressure dressing, which is typically removed after a week, and that an ophthalmic topical antibiotic ointment is applied in the socket three times daily.

After the removal of an eye, there is a loss of depth perception. Patients must be advised to take extra caution in their ambulation and movement to avoid miscalculations that may result in injury. It may take some time to adjust to monocular vision.

The patient must be advised that conformers may accidentally fall out of the socket. If this happens, the conformer must be washed, wiped dry, and placed back in the socket.

When surgical eye removal is unexpected, such as in severe ocular trauma, leaving no time for the patient and family to prepare for the loss, the nurse's role in providing emotional support is crucial.

Promoting Home, Community-Based, and Transitional Care

The patient with a new prosthetic eye may need referral to home, community-based or transitional services that provide assistance in the home. These patients also benefit from a referral for rehabilitation services.

Educating Patients about Self-Care

Patients need to be educated about how to insert, remove, and care for the prosthetic eye. Proper hand hygiene must be observed before inserting and removing an ocular prosthesis. A suction cup may be used if there are problems with manual dexterity. Precautions, such as draping a towel over the sink and closing the sink drain, must be taken to avoid loss of the

prosthesis. When instructing patients or family members, a return demonstration is important to assess the level of understanding and ability to perform the procedure.

Before insertion, the inner punctal or outer lateral aspects and the superior and inferior aspects of the prosthesis must be identified by locating the identifying marks, such as a reddish color in the inner punctal area. For people with low vision, other forms of identifying markers, such as dots or notches, are used. The upper lid is raised high enough to create a space and then the patient learns to slide the prosthesis up, underneath, and behind the upper eyelid. Meanwhile, the patient pulls the lower eyelid down to help put the prosthesis in place and to have its inferior edge fall back gradually to the lower eyelid. The lower eyelid is checked for correct positioning.

To remove the prosthesis, the patient cups one hand on the cheek to catch the prosthesis, places the forefinger of the free hand against the midportion of the lower eyelid, and gazes upward. Gazing upward brings the inferior edge of the prosthesis nearer the inferior eyelid margin. With the finger pushing inward, downward, and laterally against the lower eyelid, the prosthesis slides out into the cupped hand.

Continuing and Transitional Care

An eye prosthesis can be worn and left in place for several months. Hygiene and Pcomfort are usually maintained with daily irrigation of the prosthesis in place with normal saline solution, hard contact lens solution, or artificial tears. In the case of dry eye symptoms, the use of ophthalmic ointment lubricants or oil-based drops, such as vitamin E and mineral oil, can be helpful. Removing crusting and mucus discharge that accumulate overnight is performed with the prosthesis in place. Malpositions may occur when wiping or rubbing the prosthesis in the socket. The prosthesis can be repositioned with the use of clean fingers. Proper wiping of the prosthesis should be a gentle temporal-to-nasal motion to avoid malpositions.

The prosthesis needs to be removed and cleaned when it becomes uncomfortable and when there is increased mucus discharge. The socket should also be rendered free of mucus and inspected for any signs of infection. Any unusual discomfort, irritation, or redness of the globe or eyelids may indicate excessive wear, debris under the shell, or lack of proper hygiene. Any infection or irritation that does not resolve needs medical attention.

OCULAR CONSEQUENCES OF SYSTEMIC DISEASE

Diabetic Retinopathy

Advancements in the treatment of diabetes have enabled patients to have a relatively a normal lifespan, but many have complications of long-term diabetes. One of the most serious complications of diabetes is retinopathy. Patients with diabetes are also at higher risk of cataracts and best practices for glycemic control during cataract surgery are not known (Kumar, Seet, Eke, et al., 2016). See Chapter 31 for a detailed discussion of diabetic retinopathy.

Cytomegalovirus Retinitis

Many ophthalmic complications have been associated with AIDS, and CMV is the most common cause of retinal inflammation in patients with AIDS. Early symptoms of CMV retinitis vary from patient to patient. Some patients complain of floaters or a decrease in peripheral vision. Some have a paracentral or central scotoma, whereas others have fluctuations in vision from macular edema. The retina often becomes thin and atrophic and susceptible to retinal tears and breaks.

CMV retinitis generally takes one of three forms: hemorrhagic, brushfire, or granular. In the hemorrhagic type, large areas of white, necrotic retina may be associated with retinal hemorrhage. In the brushfire type, a yellow-white margin begins at the edge of burned-out atrophic retina. This retinitis expands and, if untreated, involves the entire retina. In the granular type, white granular lesions in the periphery of the retina gradually expand. The white, feathery infiltration of the retina destroys sensory retina and leads to necrosis, optic atrophy, and retinal detachment.

Medical Management

Management of CMV retinitis consists of prescribing the appropriate pharmacologic agent.

Pharmacologic Therapy

Pharmacologic agents available for the treatment of CMV retinitis include ganciclovir, foscarnet (Foscavir), and cidofovir (Vistide).

Ganciclovir is administered IV, orally, or intravitreously in the acute stage of CMV retinitis. The intravitreous form is available as a 4-mm intraocular implant or insert containing the medication embedded in a polymer-based system that slowly releases the medication. The insert is surgically placed in the posterior segment of the eye, and the medication diffuses locally to the site of the infection over a period of 5 to 8 months before the insert must be replaced. When given systemically, ganciclovir is a very potent medication; it can cause neutropenia, thrombocytopenia, anemia, and elevated serum creatinine levels. The surgically implanted sustained-release insert enables higher concentrations of ganciclovir to reach the CMV retinitis, but there are risks and complications associated with the inserts, including endophthalmitis, retinal detachment, and hypotony.

Foscarnet inhibits viral deoxyribonucleic acid (DNA) replication. It may be the medication of choice when ganciclovir is ineffective. It may be administered by IV or intravitreal injections. The combination of foscarnet and ganciclovir has been more effective than either medication alone. Nephrotoxicity may occur with systemic foscarnet, and renal function must be monitored carefully.

Cidofovir impedes CMV replication and is administered IV. Cidofovir has been shown to delay the progression of CMV retinitis significantly. Nephrotoxicity, proteinuria, and increased serum creatinine levels are significant side effects.

A nucleoside analog such as zidovudine (Retrovir) given in combination with one or more protease inhibitors such as ritonavir (Norvir) in the management of patients with AIDS has led to a suppression of human immune deficiency virus (HIV) replication for sustained periods. The immune system can then recover to a functional level. Some patients develop immune recovery uveitis, characterized by intraocular inflammation, cystoid macular edema, and the formation of epiretinal membranes. Immune recovery uveitis is managed by corticosteroids or by injection of corticosteroids into the sub-Tenon area of the eye.

Hypertension-Related Eye Changes

Long-standing hypertension is associated with atherosclerosis, and retinal changes are evidenced by the development of retinal arteriolar changes, such as tortuousness, narrowing, and a change in light reflex (Weber & Kelley, 2014). Funduscopic examination reveals a copper or silver coloration of the arterioles and venous compression (arteriovenous nicking) at the arteriolar and venous crossings. Intraretinal hemorrhages from hypertension appear flame shaped because they occur in the nerve fiber layer of the retina.

Hypertension can also occur as an acute consequence of conditions such as pheochromocytoma, acute kidney injury, and pregnancy-induced hypertension. The retinopathy associated with these crisis states is extensive, and the manifestations include cotton-wool spots, retinal hemorrhages, retinal edema, and retinal exudates, often clustered around the macula (Weber & Kelley, 2014).

The choroid is also affected by the profound and abrupt rise in blood pressure and resulting vasoconstriction, and ischemia may result in serious retinal detachments and infarction of the RPE. Ischemic optic neuropathy and papilledema may also result. Blood pressure in these more severe stages should be lowered in a controlled gradual fashion to avoid ischemia of the optic nerve and brain secondary to a too-rapid fall in blood pressure. See Chapter 25 for further information about hypertension.

Eye Donation

Around 36 million people suffer due to blindness all over the world. In India alone, around 8.8 million people are accounted to be living with blindness. Corneal blindness is the fourth leading cause of blindness in India with glaucoma, cataract, and age-related macular degeneration leading the list. Corneal blind people are the most suitable candidates for corneal transplant. Sharma et al. (2019) asserted that 50% of the corneal blind people can get successful visual rehabilitation following corneal transplant. There is a huge demand–supply gap in corneal tissue availability in India. There is only 1 cornea is available for every 70 corneal demands (Priyambada, 2019). To improve the eye donation, National Eye Donation Fortnight is observed between 25 August and 8 September each year. Poor awareness and lack of motivation were found to be the causes of low eye donation rates.

Possible Donors

Eye donation refers to donation of corneal tissue following clinical death or brain death of an individual by the family members or the individual. Irrespective of age, sex, religion, etc., any motivated individual can pledge to donate his or her eyes. Those who had surgeries on the eye such as cataract and people with hypertension and diabetes also can donate their eye.

Contraindications for eye donation are given in Chart 42-9. People with a history of infections such as HIV, HBV, tuberculosis, leprosy, or rabies; any active infections of the eye at the time of death; cancers in the eye; active leukemia; death from unknown cause; septicemia; and certain neurological conditions such as encephalitis, multiple sclerosis, and dementia are not eligible to donate eyes.

How to Donate Eyes

The diseased person if he or she has pledged or family members who wish to donate eye need to contact the nearest government-approved eye bank immediately following death. Within 6 hours from the death, the cornea needs to be harvested. Before the team from the eye bank arrives, relatives or family need to do the following:

- Close the eyes of the prospective donor and switch off the fans directly above to prevent corneal drying.
- If possible/available, switch on the AC.
- Refrain from applying eye ointment.
- Keep ready the death certificate issued by competent authorities.
- The legal heir of the deceased must give written consent for the donation process.

The whole process of eye harvesting is performed by a qualified and certified team from the nearest eye bank. Blood specimen—10 mL—is taken for the laboratory testing. It takes 15 to 20 minutes and does not cause any disfigurement. Either the eyes are enucleated or the corneal tissue alone is harvested and transported in a prescribed medium and preserved.

Eye Banking

An eye bank plays a major role in the identification, harvesting, preservation, and appropriate utilization of the banked corneas. Eye banks must be established following the guidelines of eye banking and should be registered by the Government of India as per the Human Organ and Tissue Transplantation Act 1994 (Eye Banking Standards, Government of India, 2020). Creation of mass awareness and grievance counseling of the prospective donor are part of the other functioning of the eye bank. The standard operating procedures are provided for the functioning of the eye bank. The preserved eyes are distributed to the suitable donors based on the priority list. The quality of the donor cornea depends on the quality of the maintenance and preservation of the tissues. Human eyes of the younger age group (younger than 45 years) are found to be of excellent quality and can reduce the post-transplant complication and result in a better clinical outcome (Pereira et al., 2021). Adherence to meticulous infection control protocols is warranted in the process of harvesting and storing. Nurses play a crucial role in education and motivation of donors. They can offer counseling and emotional support to the grieving families. Misconception of disfigurement and undue delay in proceeding for funeral can be dispelled by the nurses.

Eye Transplant

Eyes harvested from the deceased donors can be transplanted to two people. The corneal transplant or keratoplasty is otherwise called an eye transplant. The corneal transplant can help restore vision in people with corneal scarring following injuries, keratoconus, and corneal infections. A full-thickness corneal transplant (or penetrating keratoplasty) or partial-thickness corneal transplant (or deep anterior lamellar keratoplasty) can be performed. In other patients, the thin layer of corneal endothelial tissues and Descemet membrane without the supportive tissues may be transplanted. The details of nursing concern are given in the previous section on corneal surgeries.

The most common postoperative complications are infection, rejection, glaucoma, swelling of the cornea, and retinal detachment. To avoid daily doses of steroids, intravitreal steroid implants are nowadays used (Aruljothi, Anandamoorthi, Balasundaram, et al., 2021). One of the important factors that lead to poor clinical outcome is noncompliance to therapy. Patients with corneal transplant may become depressed due

to prolonged therapy and poor outcome. Nurses are in a better position to educate and counsel the patients about the importance of compliance.

CRITICAL THINKING EXERCISES

1. You are making a home visit to a 75-year-old male who has a long history of diabetes and complains that recently he is having trouble with his vision. Describe what priority assessment data you would focus on obtaining during your initial visit. What are your priorities of care of this patient with low vision? How would your priorities change if the man were blind?
2. A 45-year-old woman presents to the emergency department with family members, complaining she has had progressive loss of vision of her right eye since this morning. What are your priority assessments for this patient? What focused questions would you ask her? How would you focus your physical assessment? What surgical interventions could be appropriate to treat her? How would you prepare the patient and her family members for possible surgery?
3. A 56-year-old patient reports to you that he has been diagnosed with glaucoma but it is "no big deal" since his vision is fine. Although prescribed ophthalmic medications to treat glaucoma, he has not been self-administering them. What is the strength of the evidence that prescriptive medications are useful in preventing glaucoma-related complications? Identify the risk he is taking by not adhering to his prescribed medication regimen. Describe how you would educate him to gain his adherence to his prescribed regimen.

REFERENCES

*Asterisk indicates nursing research.

Books

American Society of Ophthalmic Registered Nurses (ASORN). (2013). Recommended practice for registered nurses –Use of multi-dose medications. San Francisco, CA: Author.

Cash, J., & Glass, C. (2016). Adult-gerontology practice guidelines. New York: Springer Publishing Company.

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Eliopoulos, C. (2018). Gerontological nursing (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Fischbach, F. T., & Dunning, M. B. (2015). A manual of laboratory and diagnostic tests (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Gerstenblith, A. T., & Rabinowitz, M. P. (2017). The Wills eye manual: Office and emergency room diagnosis and treatment of eye disease (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Grossman, S. C., & Porth, C. M. (2014). Porth's Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Hickey, J. V. (2014). The clinical practice of neurological and neurosurgical nursing (7th ed.). Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Hogan, M. (2014). Pearson's review & rationales: Pathophysiology with nursing reviews & rationales (3rd ed). New Jersey: Prentice Hall, Inc.

Prevent Blindness America. (2012). Vision problems in the U.S.: Update to the fifth edition. Schaumberg, IL: Prevent Blindness America/National Eye Institute.

Rubin, R., Strayer, D. S., & Rubin, E. (2012). Rubin's pathology: Clinicopathologic foundations of medicine (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

Aruljothi, L., Anandamoorthi, P., Balasundaram, M., et al. (2021). Strategies to improve the outcomes following corneal transplant surgery: An interpersonal approach. Trends in Transplant, 14, 1–7.

Barsam, A., & Allan, B. D. (2014). Excimer laser refractive surgery versus phakic intraocular lenses for the correction of moderate to high myopia. Cochrane Database of Systematic Reviews, (6):CD007679.

Boyd, K. (2015). What is optical coherence tomography? Retrieved on 10/5/2016 at: www.aao.org/eye-health/treatments/what-is-optical-coherence-tomography

Boyd, K. (2016). Retinal detachment: Torn or detached retina treatment. Retrieved on 1/3/2017 at: www.aao.org/eye-health/diseases/detached-torn-retina-treatment

Centers for Disease Control (CDC). (2016). Learn about age related macular degeneration. Retrieved on 12/27/2016 at: www.cdc.gov/features/healthyvisionmonth/index.html

Colour Blind Awareness. (2016). Inherited colour vision deficiency. Retrieved on 10/5/2016 at: www.colourblindawareness.org/colour-blindness/inherited.

Dickman, M. M., Peeters, J. M., Van Den Biggelmaar, F., et al. (2016). Changing practice patterns and long-term outcomes of endothelial versus penetrating keratoplasty: A prospective Dutch registry study. American Journal of Ophthalmology, 170, 133–142.

Eldaly, M. A., Bunce, C., El Sheikha, O. Z., et al. (2014). Non-penetrating filtration surgery versus trabeculectomy for open-angle glaucoma. Cochrane Database of Systematic Reviews, (2), CD007059.

Eye Banking Standards of India. (2020). Ministry of Health and Family Welfare. Government of India. Retrieved on 20/2/2022 at: www.mohfw.nic.in/www.npcbvi.gov.in.

Glaucoma Research Foundation. (2016). Five common glaucoma tests. Retrieved on 10/11/2016 at: www.glaucoma.org/glaucoma/diagnostic-tests.php

Kumar, C. M., Seet, E., Eke, T., et al. (2016). Glycaemic control during cataract surgery under loco-regional anesthesia: A growing problem and we are none the wiser. British Journal of Anesthesia, 117(6), 687–691.

Kusne, Y., Kang, P., & Fintelmann, R. E. (2016). A retrospective analysis of intraocular pressure changes after cataract surgery with the use of prednisolone acetate 1% versus difluprednate 0.05%. Clinical Ophthalmology, 10, 2326–2336.

Lee, K., & Garg, S. (2015). Navigating the current landscape of clinical genetic testing for inherited retinal dystrophies. Genetics in Medicine, 17(4), 245–252.

Li, S. M., Zhan, S., Li, S. Y., et al. (2016). Laser-assisted subepithelial keratectomy (LASEK) versus photorefractive keratectomy (PRK) for correction of myopia. Cochrane Database of Systematic Reviews, (2), Art. No.: CD009799.

Mascarenhas, A. (2017). 8.8 million blind in India in 2015. Indian express article published on 8/04/2017. Retrieved on 07/29/2018 at https://indianexpress.com/article/india/8-8-million-blind-in-india-in-2015-says-study-in-lancet-4781368/

National Programme for Control of Blindness, Ministry of Health & Family Welfare, Government of India (2018). Retrieved on April 10th, 2018, at: http://npcb.nic.in/writereaddata/mainlinkfile/File343.pdf

*Pagliuca, L. M., Macedo-Costa, K. N., Reboucas, G. B., et al. (2014). Validation of the general guidelines of communication between the nurse and the blind. Reviews Bras Enferm, 67(5), 715–725.

Patel, V., Moster, M., Kishfy, L., et al. (2016). Sequential versus concomitant surgery of glaucoma drainage implant and Boston keratoprosthesis type 1. European Journal of Ophthalmology, 26(6), 556–563.

Peng, L. H., Fong, A., Phaik, C. S., et al. (2012). Improving presurgical pupil dilation for cataract surgery patients. Joint Commission Journal on Quality and Patient Safety, 38(9), 420–425.

Paul, C., Sengupta. S., Choudhury, S., Banerjee, S., & Sleath, B. L. (2016). Prevalence of glaucoma in Eastern India: The Hooghly River Glaucoma Study. Indian Journal of Ophthalmology, 64(8), 578–583. Retrieved on April 10th, 2018, at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5056545/

Priyambada, B. (2019). Eye Donation Fortnight: India's struggle to bridge demand–supply gap for eye donation is real. Retrieved at: https://www.firstpost.com/tech/science/eye-donation-fortnight-indias-struggle-to-bridge-demand-supply-gap-for-eye-donation-is-real-7289501.html
Pereira Gruz, G. K., Ferreira Junior, M. A., Frota, O. P., et. al. (2021). Cornea donation process and tissue quality for transplantation. Retrieved on 24/2/24/2022 at: https://doi.org/10.1371/journal.pone.0249927.
Saxena, R., Singh, D., & Vashist, P. Glaucoma (2013). An emerging peril. Indian Journal of Community Medicine, 38, 135–137. Retrieved on Apr 10, 2018, at: http://www.ijcm.org.in/text.asp? 2013/38/3/135/116348
Sharma, N., Arora, T., Singhal, D., et al. (2019). Procurement, storage and utilization trends of eye banks in India. Indian Journal of Ophthalmology, 67, 1056–1059

Resources

All India Ophthalmological society, www.aios.org/
American Academy of Ophthalmology, www.aao.org
American Foundation for the Blind (AFB), www.afb.org
American Society of Ophthalmic Registered Nurses (ASORN), www.asorn.org
Association for Community Ophthalmologists of India (ACOIN) http://www.acoinsite.org
Foundation Fighting Blindness, www.blindness.org
Glaucoma Research Foundation, www.glaucoma.org
Lighthouse Guild, www.lighthouseguild.org
MAB Community Services, www.mabcommunity.org
Macular Degeneration Foundation,www.eyesight.org
National Diabetes Information Clearinghouse (NDIC), diabetes.niddk.nih.gov/dm/pubs/statistics/
National Programme for Control of Blindness, Ministry of Health & Family Welfare, Govt of India http://npcb.nic.in/
National Eye Institute Information Office, www.nei.nih.gov
Prevent Blindness America, www.preventblindness.org
Research to Prevent Blindness, www.rpbusa.org

UNIT

XIII

Kidney and Urinary Tract Function

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CHAPTER 43

Assessment of Kidney and Urinary Function

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe the structure and function of the renal and urinary systems.
2. Explain the role of the kidneys in regulating fluid and electrolyte balance, acid–base balance, and blood pressure.
3. Identify the diagnostic studies used to determine upper and lower urinary tract function and related nursing implications.
4. Discriminate between normal and abnormal assessment findings of upper and lower urinary tract function.
5. Initiate education and preparation for patients undergoing assessment of the urinary system.

GLOSSARY

aldosterone: hormone synthesized and released by the adrenal cortex; causes the kidneys to reabsorb sodium
antidiuretic hormone (ADH): hormone secreted by the posterior pituitary gland; causes the kidneys to reabsorb more water; also called *vasopressin*
anuria: decreased urine output of less than 50 mL in 24 hours
bacteriuria: bacteria in the urine
creatinine: endogenous waste product of muscle energy metabolism
diuresis: increased urine volume
dysuria: painful or difficult urination
frequency: voiding more frequently than every 3 hours
glomerular filtration rate (GFR): amount of plasma filtered through the glomeruli per unit of time
glomerulus: tuft of capillaries forming part of the nephron through which filtration occurs
hematuria: red blood cells in the urine
micturition: urination or voiding
nephron: structural and functional unit of the kidney responsible for urine formation
nocturia: awakening at night to urinate
oliguria: urine output less than 0.5 mL/kg/hr
proteinuria: protein in the urine
pyuria: white blood cells in the urine
renal clearance: ability of the kidneys to clear solutes from the plasma
renal glycosuria: excretion of glucose in the urine
specific gravity: expression of the degree of concentration of the urine
urea nitrogen: end product of protein metabolism

Introduction

Function of the renal and urinary systems is essential to life. The primary purpose of the renal and urinary systems is to maintain the body's state of homeostasis by carefully regulating fluid and electrolytes, removing wastes, and providing other functions (see Chart 43-1). Dysfunction of the kidneys and lower urinary tract is common and may occur at any age and with varying degrees of severity. Assessment of upper and lower urinary tract function is part of every health examination and requires that the nurse have an understanding of the anatomy and physiology of the urinary system as well as the effects of changes in the system on other physiologic functions.

Chart 43-1

Functions of the Kidney

- Urine formation
- Excretion of waste products
- Regulation of electrolytes
- Regulation of acid–base balance
- Control of water balance
- Control of blood pressure
- Renal clearance
- Regulation of red blood cell production
- Synthesis of vitamin D to active form
- Secretion of prostaglandins

Anatomic and Physiologic Overview

Anatomy of the Kidney and Urinary Systems

The kidney and urinary systems include the kidneys, ureters, bladder, and urethra. Urine is formed by the kidney and flows through the other structures to be eliminated from the body.

Kidneys

The kidneys are a pair of bean-shaped, brownish-red structures located retroperitoneally (behind and outside the peritoneal cavity) on the posterior wall of the abdomen—from the 12th thoracic vertebra to the 3rd lumbar vertebra in the adult (see Fig. 43-1A). The center of the concave medial border of each kidney houses a deep vertical fissure called hilum. Each hilum is penetrated with blood vessels, nerves, and the ureter (Eaton & Pooler, 2013). The average adult kidney weighs approximately 113 to 170 g and is 10 to 12 cm long, 6 cm wide, and 2.5 cm thick (Eaton & Pooler, 2013); (Grossman & Porth, 2014). The right kidney is slightly lower than the left due to the location of the liver.

Externally, the kidneys are well protected by the ribs and by the muscles of the abdomen and back. Internally, fat deposits

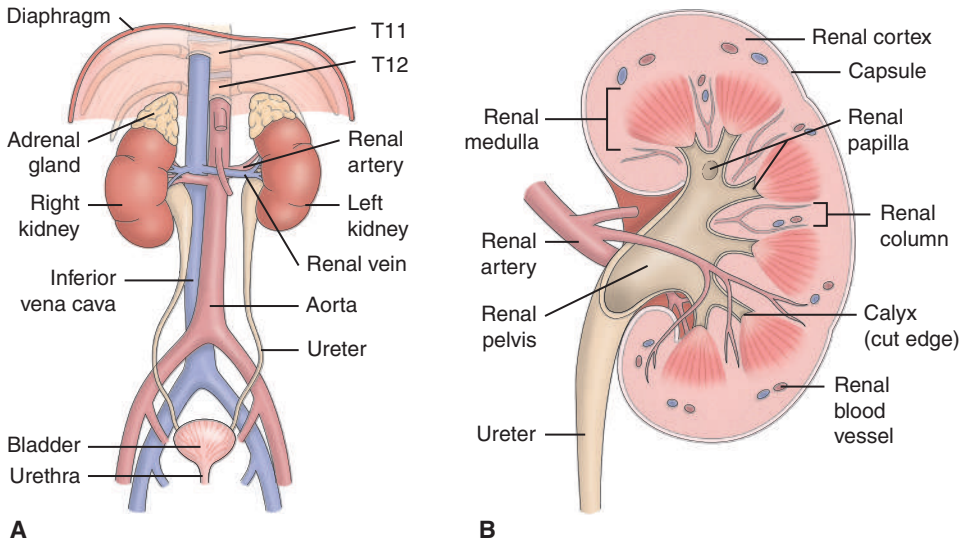


Figure 43-1 • A. Kidneys, ureters, and bladder. **B.** Internal structure of the kidney. Redrawn with permission from Porth, C. M., & Matfin, G. (2009). Pathophysiology: Concepts of altered health states (8th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

surround each kidney, providing protection against jarring. The kidneys and surrounding fat are suspended from the abdominal wall by renal fascia made of connective tissue which holds the kidney in place (Skorecki, Chertow, Marsden, 2015). The fibrous connective tissue, blood vessels, and lymphatics surrounding each kidney are known as the renal capsule. An adrenal gland lies on top of each kidney. The kidneys and adrenals are independent in function, blood supply, and innervation.

The renal parenchyma is divided into two parts: the cortex and the medulla (see Fig. 43-1B). The medulla, which is approximately 5 cm wide, is the inner portion of the kidney. It contains the loops of Henle, the vasa recta, and the collecting ducts of the juxtamedullary nephrons. The collecting ducts from both the juxtamedullary and the cortical nephrons connect to the renal pyramids, which are triangular and are situated with the base facing the concave surface of the kidney and the point (papilla) facing the hilum, or pelvis. Each kidney contains approximately 8 to 18 pyramids. The pyramids drain into minor calyces, which drain into major calyces that open directly into the renal pelvis. The tip of each pyramid is called a papilla and projects into the minor calyx (Eaton & Pooler, 2013). The renal pelvis is the beginning of the collecting system and is composed of structures that are designed to collect and transport urine. Once the urine leaves the renal pelvis, the composition or amount of urine does not change.

The cortex, which is approximately 1 cm wide, is located farthest from the center of the kidney and around the outermost edges. It contains the nephrons (the structural and functional units of the kidney responsible for urine formation), which are discussed later.

Blood Supply to the Kidneys

The hilum is the concave portion of the kidney through which the renal artery enters and the ureters and renal vein exit. The kidneys receive 20% to 25% of the total cardiac output, which means that all of the body's blood circulates through the kidneys approximately 12 times per hour (Grossman & Porth, 2014). The renal artery (arising from the abdominal aorta) divides into smaller and smaller vessels, eventually forming the afferent arterioles. Each afferent arteriole branches to form a glomerulus, which is the tuft of capillaries forming part of the nephron through which filtration occurs. Blood leaves the glomerulus through the efferent arteriole and flows back to the inferior vena cava through a network of capillaries and veins.

Nephrons

Each kidney has 1 million nephrons that are located within the renal parenchyma and are responsible for the formation of filtrate that will become urine (Eaton & Pooler, 2013). The large number of nephrons allows for adequate renal function even if the opposite kidney is damaged or becomes nonfunctional. If the total number of functioning nephrons is less than 20% of normal, renal replacement therapy needs to be considered.

There are two types of nephrons. The cortical nephrons (80% to 85%) are located in the outermost part of the cortex, and the juxtamedullary nephrons (15% to 20%) are located deeper in the cortex (Grossman & Porth, 2014). The juxtamedullary nephrons are distinguished by long loops of Henle and are surrounded by long capillary loops called *vasa recta* that dip into the medulla of the kidney. The length of the tubular component of the nephron is directly related to its ability to concentrate urine.

Nephrons are made up of two basic components: a filtering element composed of an enclosed capillary network (the glomerulus) and the attached tubule (see Fig. 43-2). The glomerulus is a unique network of capillaries suspended between the afferent and efferent blood vessels, which are enclosed in an epithelial structure called the *Bowman capsule.* The glomerular membrane is composed of three filtering layers: the capillary endothelium, the basement membrane, and the epithelium. This membrane normally allows filtration of fluid and small molecules yet limits passage of larger molecules, such as blood cells and albumin. Pressure changes and the permeability of the glomerular membrane of the Bowman capsule facilitate the passage of fluids and various substances from the blood vessels, filling the space within the Bowman capsule with this filtered solution.

The tubular component of the nephron begins in the Bowman capsule. The filtrate created in the Bowman capsule travels first into the proximal tubule, which is made up of epithelial cells resting on the basement membrane, then the loop of Henle, the distal tubule, and either the cortical or medullary collecting ducts

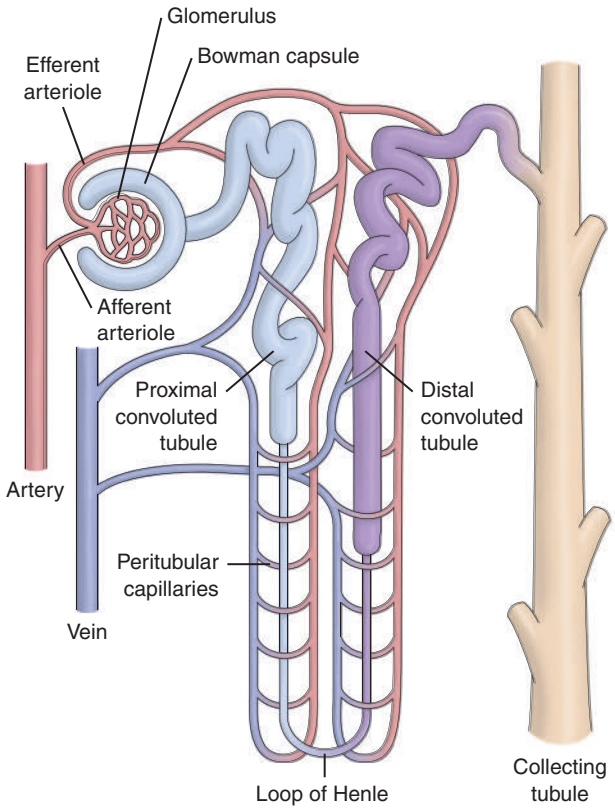


Figure 43-2 • Representation of a nephron. Each kidney has about 1 million nephrons of two types: cortical and juxtamedullary. Cortical nephrons are located in the cortex of the kidney; juxtamedullary nephrons are adjacent to the medulla.

(Eaton & Pooler, 2013). The structural arrangement of the tubule allows the distal tubule to lie in close proximity to where the afferent and efferent arterioles, respectively, enter and leave the glomerulus. The distal tubular cells located in this area, known as the macula densa, function with the adjacent afferent arteriole and create what is known as the juxtaglomerular apparatus. This is the site of renin production. Renin is a hormone directly involved in the control of arterial blood pressure; it is essential for proper functioning of the glomerulus (see later discussion).

The tubular component consists of the Bowman capsule, the proximal tubule, the descending and ascending limbs of the loop of Henle, and the cortical and medullary collecting ducts. This portion of the nephron is responsible for making adjustments in the filtrate based on the body's needs. Changes are continually made as the filtrate travels through the tubules until it enters the collecting system and is expelled from the body (see Fig. 43-2).

Ureters, Bladder, and Urethra

The urine formed in the nephrons flows through the renal calyces and then into the ureters, which are long fibromuscular tubes that connect each kidney to the bladder (Hall, 2016). These narrow tubes, each 24 to 30 cm long, originate at the lower portion of the renal pelvis and terminate in the trigone (tissue between the opening of the ureters and urethra) of the bladder wall.

The lining of the ureters is made up of transitional cell epithelium called *urothelium.* The urothelium prevents reabsorption of urine. The movement of urine from each renal pelvis through the ureter into the bladder is facilitated by peristaltic contraction of the smooth muscles in the ureter wall. Each ureter has three narrow areas that are prone to obstruction by renal calculi (kidney stones) or stricture. These three areas include the ureteropelvic junction, the ureteral segment near the sacroiliac junction, and the ureterovesical junction. Obstruction of the ureteropelvic junction is the most serious because of its close proximity to the kidney and the risk of associated kidney dysfunction.

The urinary bladder is a distensible muscular sac located just behind the pubic bone (Weber & Kelley, 2014). The usual capacity of the adult bladder is 400 to 500 mL, but it can distend to hold a larger volume. The bladder is characterized by its central, hollow area, called the *vesicle,* which has two inlets (the ureters) and one outlet (the urethra). The area surrounding the bladder neck is called the *urethrovesical junction.* The angling of the ureterovesical junction is the primary means of providing antegrade, or downward, movement of urine, also referred to as efflux of urine. This angling prevents vesicoureteral reflux (retrograde, or backward, movement of urine) from the bladder, up the ureter, toward the kidney.

The wall of the bladder contains four layers. The outermost layer is the adventitia, which is made up of connective tissue. Immediately beneath the adventitia is a smooth muscle layer known as the detrusor. Beneath the detrusor is a submucosal layer of loose connective tissue that serves as an interface between the detrusor and the innermost layer, a mucosal lining. The inner layer contains specialized transitional cell epithelium, a membrane that is impermeable to water and prevents reabsorption of urine stored in the bladder. The bladder neck contains bundles of involuntary smooth muscle that form a portion of the urethral sphincter known as the internal sphincter. An important portion of the sphincter mechanism that helps maintain continence is the external urinary sphincter at the anterior urethra, which is the segment most distal from the bladder (Grossman & Porth, 2014). During micturition (voiding or urination), increased intravesical pressure keeps the ureterovesical junction closed and urine within the ureters. As soon as micturition is completed, intravesical pressure returns to its normal low baseline value, allowing efflux of urine to resume. Therefore, the only time that the bladder is completely empty is in the last seconds of micturition, before efflux of urine resumes.

The urethra arises from the base of the bladder: In the male, it passes through the penis; in the female, it opens just anterior to the vagina. In the male, the prostate gland, which lies just below the bladder neck, surrounds the urethra posteriorly and laterally.

Function of the Kidney and Urinary Systems

Urine Formation

The healthy human body is composed of approximately 60% water. Water balance is regulated by the kidneys and results in the formation of urine. Urine is formed in the nephrons through a complex three-step process: glomerular filtration, tubular reabsorption, and tubular secretion (see Fig. 43-3). Each nephron functions independently from other nephrons because each has its own blood supply (Eaton & Pooler, 2013). The various substances normally filtered by the glomerulus, reabsorbed by the tubules, and excreted in the urine include sodium, chloride, bicarbonate, potassium, glucose, urea, creatinine, and uric acid. Within the tubule, some of these substances are selectively reabsorbed into the blood. Others are secreted from the blood into the filtrate as it travels down the tubule.

Amino acids and glucose are usually filtered at the level of the glomerulus and reabsorbed so that neither is excreted in the urine. Normally, glucose does not appear in the urine. However, renal glycosuria (excretion of glucose in the urine)

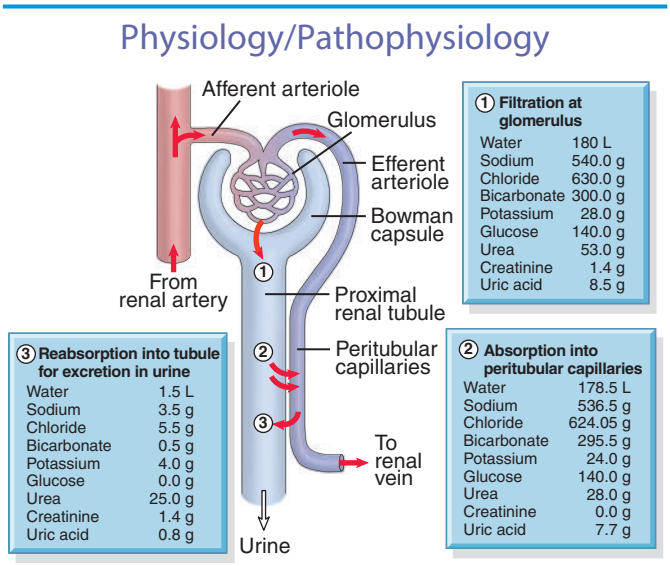


Figure 43-3 • Urine is formed in the nephrons in a three-step process: filtration, reabsorption, and secretion. Water, electrolytes, and other substances, such as glucose and creatinine, are filtered by the glomerulus; varying amounts of these substances are reabsorbed in the renal tubule or excreted in the urine. Approximate normal volumes of these substances during the steps of urine formation are shown at the top. Wide variations may occur in these values depending on diet.

occurs if the amount of glucose in the blood and glomerular filtrate exceeds the amount that the tubules are able to reabsorb. Renal glycosuria can occur on its own as a benign condition (Hall, 2016). It also occurs in poorly controlled diabetes—the most common condition that causes the blood glucose level to exceed the kidney's reabsorption capacity.

Protein molecules also are not usually found in the urine; however, low–molecular-weight proteins (globulins and albumin) may periodically be excreted in small amounts. Protein in the urine is referred to as proteinuria (Eaton & Pooler, 2013).

Glomerular Filtration

The normal blood flow through the kidneys is between 1000 and 1300 mL/min (Grossman & Porth, 2014). As blood flows into the glomerulus from an afferent arteriole, filtration occurs. The filtered fluid, also known as filtrate or ultrafiltrate, then enters the renal tubules. Under normal conditions, about 20% of the blood passing through the glomeruli is filtered into the nephron, amounting to about 180 L/day of filtrate (Eaton & Pooler, 2013). The filtrate normally consists of water, electrolytes, and other small molecules, because water and small molecules are allowed to pass, whereas larger molecules stay in the bloodstream. As blood enters the glomerulus from the afferent arteriole, filtration depends on adequate blood flow that maintains a consistent pressure through the glomerulus called hydrostatic pressure. Many factors can alter this blood flow and pressure, including hypotension, decreased oncotic pressure in the blood, and increased pressure in the renal tubules from an obstruction (Eaton & Pooler, 2013); (Grossman & Porth, 2014).

Tubular Reabsorption and Tubular Secretion

The second and third steps of urine formation occur in the renal tubules. In tubular reabsorption, a substance moves from the filtrate back into the peritubular capillaries or vasa recta. In tubular secretion, a substance moves from the peritubular capillaries or vasa recta into tubular filtrate. Of the 180 L of filtrate that the kidneys produce each day, 99% is reabsorbed into the bloodstream, resulting in the formation of 1 to 2 L of urine each day. Although most reabsorption occurs in the proximal tubule, reabsorption occurs along the entire tubule. Reabsorption and secretion in the tubule frequently involve passive and active transport and may require the use of energy. Tubular secretion occurs when substances move from the peritubular capillary blood plasma (blood) into the tubular lumen (filtrate). Tubular secretion helps with the elimination of potassium, hydrogen ions, ammonia, uric acid, some drugs, and other waste products (Headly, 2015). Filtrate becomes concentrated in the distal tubule and collecting ducts under hormonal influence and becomes urine, which then enters the renal pelvis. In the absence of tubular reabsorption, volume depletion would rapidly occur (Headly, 2015).

Antidiuretic Hormone

Antidiuretic hormone (ADH), also known as vasopressin, is a hormone that is secreted by the posterior portion of the pituitary gland in response to changes in osmolality of the blood. With decreased water intake, blood osmolality tends to increase, stimulating ADH release. ADH then acts on the kidney, increasing reabsorption of water and thereby returning the osmolality of the blood to normal. With excess water intake, the secretion of ADH by the pituitary is suppressed; therefore, less water is reabsorbed by the kidney tubule, leading to diuresis (increased urine volume).

A dilute urine with a fixed specific gravity (about 1.010) or fixed osmolality (about 300 mOsm/L) indicates an inability to concentrate and dilute the urine, which is a common early sign of kidney disease (Skorecki et al., 2015).

Osmolarity and Osmolality

Osmolarity refers to the ratio of solute to water. The regulation of salt and water is paramount for control of the extracellular volume and both serum and urine osmolarity. Controlling either the amount of water or the amount of solute can change osmolarity. Osmolarity and ionic composition are maintained by the body within very narrow limits. As little as a 1% to 2% change in the serum osmolarity can cause a conscious desire to drink and conservation of water by the kidneys (Skorecki et al., 2015).

The degree of dilution or concentration of the urine is also measured in terms of osmolality (the number of osmoles [the standard unit of osmotic pressure] dissolved per kilogram of solution). The filtrate in the glomerular capillary normally has the same osmolality as the blood—280 to 300 mOsm/kg. Serum and urine osmolality and osmolarity are discussed in more detail in Chapter 7.

Regulation of Water Excretion

Regulation of the amount of water excreted is an important function of the kidney. With high fluid intake, a large volume of dilute urine is excreted. Conversely, with a low fluid intake, a small volume of concentrated urine is excreted. A person normally ingests about 1300 mL of oral liquids and 1000 mL of water in food per day. Of the fluid ingested, approximately 900 mL is lost through the skin and lungs (called *insensible loss*), 50 mL through sweat, and 200 mL through feces. It is important to consider all fluid gained and lost when evaluating total fluid status. Daily weight measurements are a reliable means of determining overall fluid status.1 Kg weight gain approximately equals to 1000 mL, so a weight change of as little as 0.5 kg could suggest an overall fluid gain or loss of 500 mL (Grossman & Porth, 2014).

Regulation of Electrolyte Excretion

When the kidneys are functioning normally, the volume of electrolytes excreted per day is equal to the amount ingested. For example, the average Indian diet contains more than twice the WHO recommended sodium, approximately 10.98 g of salt. The consumption of salt ranges from 5.22 to 42.30 g/day. They eat e more of salt-cured items such as pickle, dried fish, and also add salt on the table. There is a great variation in sodium intake according to the region; people of southern and eastern states of India consume comparatively more salt than the people of Uttar Pradesh, Uttarakhand, Punjab, Haryana, Gujarat, and Maharashtra. With increase in the consumption of packed ready-to-eat items the mean salt consumption is likely to increase still more (Johnson. C., Praveen. D., Pope. A., et.al, 2017).

The regulation of sodium volume excreted depends on aldosterone, a hormone synthesized and released by the adrenal cortex. With increased aldosterone in the blood, less sodium is excreted in the urine, because aldosterone fosters renal reabsorption of sodium. Release of aldosterone from the adrenal cortex is largely under the control of angiotensin II. Angiotensin II levels are in turn controlled by renin, an enzyme that is released from specialized cells in the kidneys (see Fig. 43-4). This complex system is activated when pressure in the renal arterioles falls below normal levels, as occurs with shock, dehydration, or decreased sodium chloride delivery to the tubules. Activation of this system increases the retention of water and expansion of the intravascular fluid volume, thereby maintaining enough pressure within the glomerulus to ensure adequate filtration.

The regulation of serum sodium and potassium are discussed in detail in Chapter 7.

Regulation of Acid–Base Balance

The normal serum pH is about 7.35 to 7.45 and must be maintained within this narrow range for optimal physiologic function (Grossman & Porth, 2014). The kidney performs major functions to assist in this balance. One function is to reabsorb and return to the body's circulation any bicarbonate from the urinary filtrate; other functions are to excrete or reabsorb acid, synthesize ammonia, and excrete ammonium chloride (Headly, 2015). Because bicarbonate is a small ion, it is freely filtered at the glomerulus. The renal tubules actively reabsorb most of the bicarbonate in the urinary filtrate. To replace any lost bicarbonate, the renal tubular cells generate new bicarbonate through a variety of chemical reactions. This newly generated bicarbonate is then reabsorbed by the tubules and returned to the body.

The body's acid production is the result of catabolism, or breakdown, of proteins, which produces acid compounds, particularly phosphoric and sulfuric acids. The normal daily diet also includes a certain amount of acid materials. Unlike carbon dioxide (CO_2), phosphoric and sulfuric acids cannot be eliminated by the lungs. Because accumulation of these acids in the blood lowers pH (making the blood more acidic) and inhibits cell function, they must be excreted in the urine. However, if the hydrogen ions are low, they will be reabsorbed. A person with normal kidney function excretes about 70 mEq of acid each day. The kidney is able to excrete some of this acid directly into the urine until the urine pH reaches 4.5, which is 1000 times more acidic than blood (Grossman & Porth, 2014).

However, more acid usually needs to be eliminated from the body than can be secreted directly as free acid in the urine. These excess acids are bound to chemical buffers so that they can be excreted in the urine. Two important chemical buffers are phosphate ions and ammonia (NH_3). When buffered with acid, ammonia becomes ammonium (NH_4^+). Phosphate is present in the glomerular filtrate, and ammonia is produced by the cells of the renal tubules and secreted into the tubular fluid. Through the buffering process, the kidney is able to excrete large quantities of acid in a bound form without further lowering the pH of the urine.

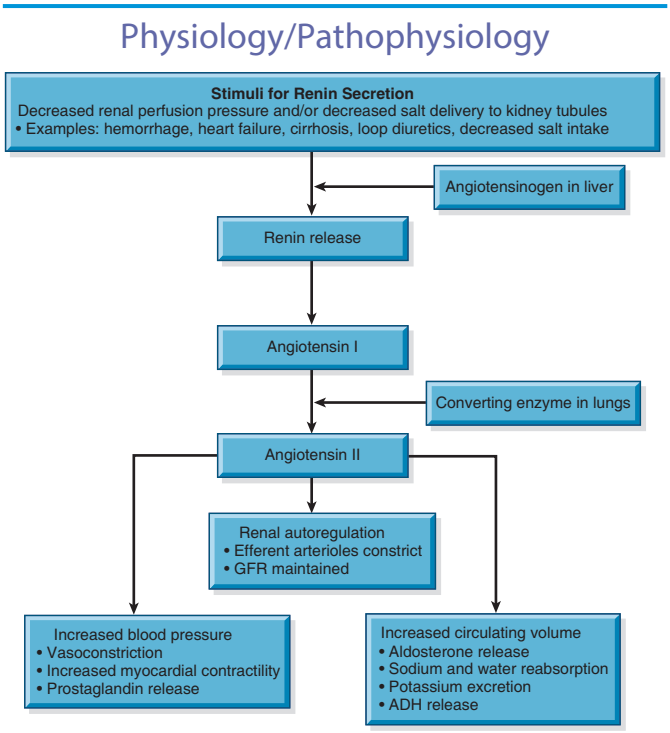


Figure 43-4 • The renin–angiotensin system. GFR, glomerular filtration rate; ADH, antidiuretic hormone.

Autoregulation of Blood Pressure

Regulation of blood pressure is an important function of the kidney. Specialized vessels of the kidney, called the *vasa recta,* constantly monitor blood pressure as blood begins its passage into the kidney. When the vasa recta detect a decrease in blood pressure, specialized juxtaglomerular cells near the afferent arteriole, distal tubule, and efferent arteriole, secrete the hormone renin. Renin converts angiotensinogen to angiotensin I, which is then converted to angiotensin II—the most powerful vasoconstrictor known; angiotensin II causes the blood pressure to increase (Hall, 2016). The adrenal cortex secretes aldosterone in response to stimulation by the pituitary gland, which occurs in response to poor perfusion or increasing serum osmolality. The result is an increase in blood pressure. When the vasa recta recognize the increase in blood pressure, renin secretion stops. Failure of this feedback mechanism is one of the primary causes of hypertension (see Fig. 43-4).

Renal Clearance

Renal clearance refers to the ability of the kidneys to clear solutes from the plasma. A 24-hour collection of urine is the primary test of renal clearance used to evaluate how well the kidney performs this important excretory function. Renal clearance depends on several factors: how quickly the substance is filtered across the glomerulus, how much of the substance is reabsorbed along the tubules, and how much of the substance is secreted into the tubules. It is possible to measure the renal clearance of

any substance, but the one measure that is particularly useful is the creatinine clearance.

Creatinine is an endogenous waste product of skeletal muscle that is filtered at the glomerulus, passed through the tubules with minimal change, and excreted in the urine. Hence, creatinine clearance is a good measure of the glomerular filtration rate (GFR), the amount of plasma filtered through the glomeruli per unit of time. To calculate creatinine clearance, a 24-hour urine specimen is collected. Midway through the collection, the serum creatinine level is measured. The following formula is then used to calculate the creatinine clearance:

$$\frac{(\text{Volume of urine [mL/min]} \times \text{Urine creatinine [mL/dL]})}{\text{Serum creatinine (mg/dL)}}$$

The adult GFR can vary from a normal of approximately 125 mL/min (1.67 to 2 mL/sec) to a high of 200 mL/min (Grossman & Porth, 2014). Creatinine clearance is the best approximation of renal function. As renal function declines, both creatinine clearance and renal clearance (the ability to excrete solutes) decrease.

Regulation of Red Blood Cell Production

When the kidneys detect a decrease in the oxygen tension in renal blood flow, because of anemia, arterial hypoxia, or inadequate blood flow, the juxtaglomerular apparatus releases erythropoietin. Erythropoietin is a glycoprotein from the kidney that stimulates the bone marrow to produce red blood cells (RBCs), which carry oxygen throughout the body (Eaton & Pooler, 2013).

Vitamin D Synthesis

The kidneys are also responsible for the final conversion of inactive vitamin D to its active form, 1,25-dihydroxycholecalciferol. Vitamin D is necessary for maintaining normal calcium balance in the body.

Secretion of Prostaglandins and other Substances

The kidneys also produce prostaglandin E and prostacyclin, thromboxanes and leukotrienes, which have vasoactive effects. These substances help the afferent and efferent arterioles maintain renal blood flow by causing selective vasodilation or vasoconstriction (Headly, 2015).

Excretion of Waste Products

The kidneys eliminate the body's metabolic waste products. The major waste product of protein metabolism is urea, of which about 25 to 30 g are produced and excreted daily (Grossman & Porth, 2014). All of this urea must be excreted in the urine; otherwise, it accumulates in body tissues. Other waste products of metabolism that must be excreted are creatinine, phosphates, and sulfates. Uric acid, formed as a waste product of purine metabolism, is also eliminated in the urine. The kidneys serve as the primary mechanism for excreting drug metabolites.

Urine Storage

The bladder is the reservoir for urine. Both filling and emptying of the bladder are mediated by coordinated sympathetic and parasympathetic nervous system control mechanisms involving the detrusor muscle and the bladder outlet. Conscious awareness of bladder filling occurs as a result of sympathetic neuronal pathways that travel via the spinal cord to the level of T10 through T12, where peripheral, hypogastric nerve innervation allows for continued bladder filling. As bladder filling continues, stretch receptors in the bladder wall are activated, coupled with the desire to void. This information from the detrusor muscle is relayed back to the cerebral cortex via the parasympathetic pelvic nerves at the level of S1 through S4 (Grossman & Porth, 2014). Overall bladder pressure remains low due to the bladder's compliance (ability to expand or collapse) as urine volume changes.

Bladder compliance is due in part to the smooth muscle lining of the bladder and collagen deposits within the wall of the bladder, as well as to neuronal mechanisms that inhibit the detrusor muscle from contracting (specifically, adrenergic receptors that mediate relaxation). To maintain adequate kidney filtration rates, bladder pressure during filling must remain lower than 40 cm water (H_2O). This low pressure allows the urine to freely leave the renal pelvis and enter the ureters. The sensation of bladder fullness is transmitted to the central nervous system when the bladder has reached about 150 to 200 mL in adults, and an initial desire to void occurs (Hall, 2016). A marked sense of fullness and discomfort with a strong desire to void usually occurs when the bladder reaches its functional capacity of 400 to 500 mL of urine. Neurologic changes to the bladder at the level of the supraspinal nerves, the spinal nerves, or the bladder wall itself can cause abnormally high volumes (up to 2000 mL) of urine to be stored due to a decreased or absent urge to void.

Under normal circumstances with average fluid intake of approximately 1 to 2 L/day, the bladder should be able to store urine for periods of 2 to 4 hours at a time during the day (Hall, 2016). At night, the release of vasopressin in response to decreased fluid intake causes a decrease in the production of urine and makes it more concentrated. This phenomenon usually allows the bladder to continue filling for periods of 6 to 8 hours in adolescents and adults, making them able to sleep for longer periods before needing to void. In older adults, decreasing bladder compliance and decreased vasopressin levels often cause nocturia (awakening during the night to urinate).

Bladder Emptying

Micturition normally occurs approximately eight times in a 24-hour period. It is activated via the micturition reflex arc within the sympathetic and parasympathetic nervous systems, which causes a coordinated sequence of events. Initiation of voiding occurs when the efferent pelvic nerve, which originates in the S1 to S4 area, stimulates the bladder to contract, resulting in complete relaxation of the striated urethral sphincter. This is followed by a decrease in urethral pressure, contraction of the detrusor muscle, opening of the vesicle neck and proximal urethra, and flow of urine. This coordinated effort by the parasympathetic system is mediated by muscarinic and, to a lesser extent, cholinergic receptors within the detrusor muscle. The pressure generated in the bladder during micturition is about 20 to 40 cm H_2O in females. It is somewhat higher and more variable in males 45 years and older due to the normal hyperplasia of the cells of the middle lobes of the prostate gland, which surround the proximal urethra. Any obstruction of the bladder outlet, such as in advanced benign prostatic hyperplasia (BPH), results in a high voiding pressure. High voiding pressures make it more difficult to start urine flow and maintain it.

If the spinal pathways from the brain to the urinary system are destroyed (e.g., after a spinal cord injury), reflex contraction of the bladder is maintained, but voluntary control over the process is lost. In both situations, the detrusor muscle can contract and expel urine, but the contractions are generally insufficient to empty the bladder completely, so residual urine (urine left in the bladder after voiding) remains. Normally, residual urine amounts to no more than 50 mL in the middle-aged adult and less than 50 to 100 mL in the older adult (Weber & Kelley, 2014).

Gerontologic Considerations

Upper and lower urinary tract function changes with age. The GFR decreases, starting between 35 and 40 years of age, and a yearly decline of about 1 mL/min continues thereafter. Older adults are more susceptible to acute and chronic kidney injury due to the structural and functional changes in the kidney. Examples include sclerosis of the glomerulus and renal vasculature, decreased blood flow, decreased GFR, altered tubular function, and acid–base imbalance. Although renal function usually remains adequate, renal reserve is decreased and may reduce the kidneys' ability to respond effectively to drastic or sudden physiologic changes. This steady decrease in glomerular filtration, combined with the use of multiple medications in which metabolites are cleared by the kidneys, puts the older person at higher risk for adverse drug effects and drug–drug interactions (Eliopoulos, 2018).

Older adults are more prone to develop hypernatremia and fluid volume deficit, because increasing age is also associated with diminished osmotic stimulation of thirst. Thirst is defined as one's awareness of the desire to drink. The sense of thirst is so protective that hypernatremia almost never occurs in adults younger than 60 years.

Structural or functional abnormalities that occur with aging may also prevent complete emptying of the bladder. This may be due to decreased bladder wall contractility; secondary to myogenic or neurogenic factors; or related to bladder outlet obstruction, such as in BPH or after prostatectomy. Vaginal and urethral tissues atrophy (become thinner) in aging women due to decreased estrogen levels. This causes decreased blood supply to the urogenital tissues, resulting in urethral and vaginal irritation and urinary incontinence.

Urinary incontinence is present in 15% to 30% of community-dwelling older adults, 50% of older adults who are institutionalized, and 30% of older adults who are hospitalized (Eliopoulos, 2018). Many older adults and their families are unaware that urinary incontinence stems from many causes. The nurse needs to inform the patient and family that with appropriate evaluation, urinary incontinence can often be managed at home, and in many cases it can be eliminated. Many treatments are available for urinary incontinence in older adults, including noninvasive, behavioral interventions that the patient or caregiver can carry out. Treatment modalities for urinary incontinence are described in further detail in Chapter 45.

Preparation of the older adult patient for diagnostic tests must be managed carefully to prevent dehydration, which might precipitate kidney disease in a patient with marginal renal function. Limitations in mobility may affect an older patient's ability to void adequately or to consume an adequate volume of fluids. The patient may limit fluid intake to minimize the frequency of voiding or the risk of incontinence.

Nursing Alert: Providing education about the dangers of an inadequate fluid intake is an important role of the nurse caring for the older patient. The nurse emphasizes the need to drink throughout the day even if the patient does not feel thirsty, because the thirst stimulation is decreased.

Older women often have incomplete emptying of the bladder and urinary stasis, which may result in urinary tract infection or increasing bladder pressure, leading to overflow incontinence, hydronephrosis, pyelonephritis, or chronic kidney disease (Eliopoulos, 2018). Urologic symptoms can mimic disorders such as appendicitis, peptic ulcer disease, and cholecystitis, which can make diagnosis difficult in older adults due to decreased neurologic innervation (Eliopoulos, 2018).

Assessment of the Kidney and Urinary Systems

Health History

Obtaining a urologic health history requires excellent communication skills, because many patients are embarrassed or uncomfortable discussing genitourinary function or symptoms (Weber & Kelley, 2014). It is important to use language the patient can understand and to avoid medical jargon. It is also important to review risk factors, particularly for those patients who are at high risk. For example, the nurse needs to be aware that multiparous women delivering their children vaginally have a high risk for stress urinary incontinence, which, if severe enough, can also lead to urge incontinence. People with neurologic disorders such as diabetic neuropathy, multiple sclerosis, or Parkinson disease often have incomplete emptying of the bladder and urinary stasis, which may result in urinary tract infection or increasing bladder pressure, leading to overflow incontinence, hydronephrosis, pyelonephritis, or chronic kidney disease (Eliopoulos, 2018). Risk factors for specific disorders and kidney and lower urinary tract dysfunction are summarized in Table 43-1 and discussed in Chapters 44 and 45.

When obtaining the health history, the nurse should inquire about the following:

- The patient's chief concern or reason for seeking health care, the onset of the problem, and its effect on the patient's quality of life
- The location, character, and duration of pain, if present, and its relationship to voiding; factors that precipitate pain, and those that relieve it
- History of urinary tract infections, including past treatment or hospitalization for urinary tract infection
- Fever or chills
- Previous renal or urinary diagnostic tests, surgeries or procedures; or the use of indwelling urinary catheters
- Dysuria (painful or difficult urination), as well as during voiding (i.e., at initiation or at termination of voiding) this occurs
- Hesitancy, straining, or pain during or after urination
- Urinary incontinence (stress incontinence, urge incontinence, overflow incontinence, or functional incontinence)
- Hematuria (RBCs in the urine) or change in color or volume of urine
- Nocturia and its date of onset
- Renal calculi (kidney stones), passage of stones or gravel in urine
- In female patients, the number and type (vaginal or cesarean) of deliveries; the use of forceps; vaginal infection, discharge, or irritation; contraceptive practices
- History of anuria (decreased urine production of less than 50 mL in 24 hours) or other kidney problem
- Presence or history of genital lesions or sexually transmitted infections
- The use of tobacco, alcohol, or recreational drugs
- Any prescription and over-the-counter medications (including those prescribed for renal or urinary problems)

TABLE 43-1 Risk Factors for Selected Renal or Urologic Disorders

Risk Factor	Possible Renal or Urologic Disorder
Advanced age	Incomplete emptying of bladder, leading to urinary tract infection and urosepsis
Benign prostatic hyperplasia	Obstruction to urine flow, leading to frequency, oliguria, anuria
Diabetes	Chronic kidney disease, neurogenic bladder
Gout, hyperparathyroidism, Crohn's disease, ileostomy	Kidney stone formation
Hypertension	Renal insufficiency, chronic kidney failure
Instrumentation of urinary tract, cystoscopy, catheterization	Urinary tract infection, incontinence
Immobilization	Kidney stone formation
Multiple sclerosis	Incontinence, neurogenic bladder, and other complications
Occupational, recreational, or environmental exposure to chemicals (plastics, pitch, tar, rubber)	Acute kidney failure
Obstetric injury, tumors	Incontinence
Parkinson disease	Incontinence and other complications
Pregnancy	Proteinuria, frequent voiding
Radiation therapy to pelvis	Cystitis, fibrosis of ureter, or fistula in urinary tract
Recent pelvic surgery	Inadvertent trauma to ureters or bladder
Sickle cell disease, multiple myeloma	Chronic kidney disease
Spinal cord injury	Neurogenic bladder, urinary tract infection, incontinence
Strep throat, impetigo, nephrotic syndrome	Chronic kidney disease
Systemic lupus erythematosus	Nephritis, chronic kidney disease

Common Symptoms

Dysfunction of the kidney can produce a complex array of symptoms throughout the body. Pain, changes in voiding, and gastrointestinal symptoms are particularly suggestive of urinary tract disease.

Pain

Genitourinary pain is usually caused by distention of some portion of the urinary tract as a result of obstructed urine flow or inflammation and swelling of tissues. Severity of pain is related to the sudden onset, rather than the extent of distention.

Table 43-2 lists the various types of genitourinary pain, characteristics of the pain, associated signs and symptoms, and possible causes. However, kidney disease does not always involve pain. It tends to be diagnosed because of other symptoms that cause a patient to seek health care, such as pedal edema, shortness of breath, and changes in urine elimination (Weber & Kelley, 2014).

Changes in Voiding

Micturition is normally a painless function that occurs approximately eight times in a 24-hour period. The average person voids 1 to 2 L of urine in 24 hours, although this amount varies depending on fluid intake, sweating, environmental temperature, vomiting, or diarrhea. Common problems associated with voiding include frequency (voiding more frequently than every 3 hours), urgency, dysuria, hesitancy, incontinence, enuresis, polyuria, oliguria, and hematuria. These problems and others are described in Table 43-3. Increased urinary urgency and frequency, coupled with decreasing urine volumes strongly suggest urine retention. Depending on the acuity of the onset of these symptoms, immediate bladder emptying via catheterization and evaluation may be necessary to prevent kidney dysfunction.

Gastrointestinal Symptoms

Gastrointestinal signs and symptoms are often associated with urologic conditions because of shared autonomic and sensory innervation and renointestinal reflexes (see Table 43-3). The proximity of the right kidney to the colon, duodenum, head of the pancreas, common bile duct, liver, and gallbladder may cause gastrointestinal disturbances. The proximity of the left kidney to the colon (splenic flexure), stomach, pancreas, and spleen may also result in intestinal symptoms. The most

TABLE 43-2 Identifying Characteristics of Genitourinary Pain

Type	Location	Characteristics	Associated Signs and Symptoms	Possible Etiology
Kidney	Costovertebral angle, may extend to umbilicus	Dull constant ache; if sudden distention of capsule, pain is severe, sharp, stabbing, and colicky in nature	Nausea and vomiting, diaphoresis, pallor, signs of shock	Acute obstruction, kidney stone, blood clot, acute pyelonephritis, trauma
Bladder	Suprapubic area	Dull, continuous pain that may be intense with voiding; may be severe if bladder full	Urgency, pain at end of voiding, painful straining	Overdistended bladder, infection, interstitial cystitis; tumor
Ureteral	Costovertebral angle, flank, lower abdominal area, testis, or labium	Severe, sharp, stabbing pain, colicky in nature	Nausea and vomiting, paralytic ileus	Ureteral stone, edema or stricture, blood clot
Prostatic	Perineum and rectum	Vague discomfort, feeling of fullness in perineum, vague back pain	Suprapubic tenderness, obstruction to urine flow; frequency, urgency, dysuria, nocturia	Prostatic cancer, acute or chronic prostatitis
Urethral	*Male*: Along penis to meatus *Female*: Urethra to meatus	Pain variable, most severe during and immediately after voiding	Frequency, urgency, dysuria, nocturia, urethral discharge	Irritation of bladder neck, infection of urethra, trauma, foreign body in lower urinary tract

TABLE 43-3 Problems Associated with Changes in Voiding

Problem	Definition	Possible Etiology
Anuria	Urine output <50 mL/day	Acute or chronic kidney injury (see Chapter 44), complete obstruction
Bacteriuria	Bacterial count >100,000 colonies/mL in the urine	Infection
Dysuria	Painful or difficult voiding	Lower urinary tract infection, inflammation of bladder or urethra, acute prostatitis, stones, foreign bodies, tumors in bladder
Enuresis	Involuntary voiding during sleep	Delay in functional maturation of central nervous system (bladder control usually achieved by 5 years of age), obstructive disease of lower urinary tract, genetic factors, failure to concentrate urine, urinary tract infection, psychological stress
Frequency	Frequent voiding—more than every 3 hours	Infection, obstruction of lower urinary tract leading to residual urine and overflow, anxiety, diuretic agents, benign prostatic hyperplasia, urethral stricture, diabetic neuropathy
Hematuria	Red blood cells in the urine	Cancer of genitourinary tract, acute glomerulonephritis, renal stones, renal tuberculosis, blood dyscrasia, trauma, extreme exercise, rheumatic fever, hemophilia, leukemia, sickle cell trait or disease
Hesitancy	Delay, difficulty in initiating voiding	Benign prostatic hyperplasia, compression of urethra, outlet obstruction, neurogenic bladder
Incontinence	Involuntary loss of urine	External urinary sphincter injury, obstetric injury, lesions of bladder neck, detrusor dysfunction, infection, neurogenic bladder, medications, neurologic abnormalities
Nocturia	Awakening during the night to urinate	Decreased renal concentrating ability, heart failure, diabetes, incomplete bladder emptying, excessive fluid intake at bedtime, nephrotic syndrome, cirrhosis with ascites
Oliguria	Urine output <0.5 mL/kg/hr	Acute or chronic kidney failure (see Chapter 44), inadequate fluid intake
Polyuria	Increased volume of urine voided	Diabetes, diabetes insipidus, the use of diuretics, excess fluid intake, lithium toxicity, some forms of kidney disease (hypercalcemic and hypokalemic nephropathy)
Proteinuria	Protein in the urine	Acute and chronic kidney disease, nephrotic syndrome, vigorous exercise, heat stroke, severe heart failure, diabetic nephropathy, multiple myeloma
Urgency	Strong desire to void	Infection, chronic prostatitis, urethritis, obstruction of lower urinary tract leading to residual urine and overflow, anxiety, diuretic agents, benign prostatic hyperplasia, urethral stricture, diabetic neuropathy

common signs and symptoms are nausea, vomiting, diarrhea, abdominal discomfort, and abdominal distention.

Unexplained Anemia

Gradual kidney dysfunction can be insidious in its presentation, although fatigue is a common symptom. Fatigue, shortness of breath, and exercise intolerance all result from the condition known as "anemia of chronic disease."

Past Health, Family, and Social History

Data collection about previous health problems or diseases provides the health care team with useful information for evaluating the patient's current urinary status. People with diabetes who have hypertension are at risk for renal dysfunction. Older men are at risk for prostatic enlargement, which causes urethral obstruction and can result in urinary tract infections and kidney disease. People with a family history of urinary tract problems are at increased risk for renal disorders. Genetics may also influence renal conditions (see Chart 43-2).

It is also important to assess the patient's psychosocial status, level of anxiety, perceived threats to body image, available support systems, and sociocultural patterns.

Physical Assessment

Several body systems can affect upper and lower urinary tract dysfunction, and conversely that dysfunction can affect several end organs; therefore, a head-to-toe assessment is indicated. Areas of emphasis include the abdomen, suprapubic region, genitalia, lower back, and lower extremities.

The kidneys are not usually palpable. However, palpation of the kidneys may detect an enlargement that could prove to be very important (Weber & Kelley, 2014). The correct technique for palpation is illustrated in Figure 43-5. It may be possible to palpate the smooth, rounded lower pole of the kidney between the hands. The right kidney is easier to detect, because it is somewhat lower than the left one. In patients who are obese, palpation of the kidneys is more difficult.

Renal dysfunction may produce tenderness over the costovertebral angle, which is the angle formed by the lower border of the 12th, or bottom, rib and the spine (see Fig. 43-6). The abdomen (just slightly to the right and left of the midline in both upper quadrants) is auscultated to assess for bruits (low-pitched murmurs that indicate renal artery stenosis or an aortic aneurysm). The abdomen is also assessed for the presence of ascites (accumulation of fluid in the peritoneal cavity), which may occur with kidney as well as liver dysfunction.

To check for residual urine, the bladder should be percussed after the patient voids. Percussion of the bladder begins at the midline just above the umbilicus and proceeds downward. The sound changes from tympanic to dull when percussing over the bladder. The bladder, which can be palpated only if it is moderately distended, feels like a smooth, firm, round mass rising out of the abdomen, usually at midline (see Fig. 43-7). Dullness to percussion of the bladder after voiding indicates incomplete bladder emptying (Weber & Kelley, 2014). Portable bladder ultrasonography is another method of detecting urinary retention. These devices provide a three-dimensional image of the bladder and should be used 10 minutes after voiding to detect urine retention (Davis, Chrisman, & Walden, 2012). See later discussion in bladder ultrasonography section.

In older men, BPH or prostatitis can cause difficulty with urination. Because the signs and symptoms of prostate cancer can mimic those of BPH, the prostate gland is palpated by digital rectal examination (DRE) as part of the yearly physical examination in men 40 years and older (see Chapter 46). In addition, a blood specimen is obtained to test the

Chart 43-2 GENETICS IN NURSING PRACTICE

Kidney and Urinary Disorders

Various conditions that affect the renal system and urinary tract function are influenced by genetic factors. Some examples of these genetic disorders are:

Autosomal Dominant:
- Familial Wilms tumor
- Polycystic kidney disease
- Renal cystic disease in tuberous sclerosis complex

X-Linked Recessive:
- Alport syndrome (primarily X-linked but autosomal dominant and recessive forms exist)

Congenital Kidney Disorders:
- Congenital absence of the vas deferens (caused by *CFTR* gene mutation for cystic fibrosis)
- Horseshoe kidney
- Multicystic dysplastic kidneys

Other Genetic Disorders that Impact the Renal System:
- Alpha-1 antitrypsin deficiency
- Anderson–Fabry disease
- Diabetes
- Coronary artery disease
- Pulmonary hypertension
- Von Hippel–Lindau syndrome

Nursing Assessments

Family History Specific to Kidney and Urinary Disorders

- Inquire about other family members with a history of renal and/or urinary tract malformations, kidney disease, or end-stage kidney disease and age of onset.
- Determine if other family members have diabetic kidney disease (clustering of this within the family could indicate genetic susceptibility).
- Identify family history of male infertility and cystic fibrosis (congenital absence of vas deferens).
- Be alert to family members with history of early-onset renal (Wilms tumor) or other cancers.

Physical Assessment Specific to Genetic Kidney and Urinary Disorders

- Be alert to signs and symptoms of kidney disease at an early age.
- Ascertain for presence and frequency of kidney stones or urinary tract infections.
- Assess for the presence and frequency of:
  - Abdominal pain or presence of an abdominal mass
  - Hematuria
  - Hypertension
  - Peripheral or orbital edema
  - Proteinuria
- Assess for clinical findings suggesting that kidney disease is a component of a genetic syndrome (e.g., seizures, intellectual disability, skin involvement).
- Assess for bleeding tendencies, abnormal clotting, or history of anemia.

Genetics Resources

Alport Syndrome Foundation, www.alportsyndrome.org
The National Kidney Foundation (India) (NKFI), http://www.nkfi.in/



Figure 43-5 • The left kidney is palpated by reaching over to the patient's left side and placing the left hand beneath the patient's lower left rib. Push the hand on top forward as the patient inhales deeply.

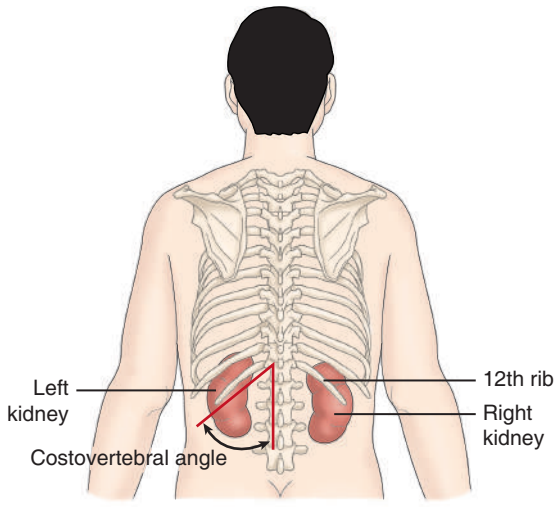


Figure 43-6 • Location of the costovertebral angle.

prostate-specific antigen (PSA) level annually; the results of the DRE and PSA are then correlated. Blood is drawn for PSA before the DRE, because manipulation of the prostate can cause the PSA level to increase temporarily. The inguinal area is examined for enlarged nodes, an inguinal or femoral hernia, and varicocele (varicose veins of the spermatic cord).

In women, the vulva, urethral meatus, and vagina are examined (Weber & Kelley, 2014). The urethra is palpated for diverticula, and the vagina is assessed for adequate estrogen effect and any of five types of herniation: urethrocele, cystocele, pelvic prolapse, enterocele, and rectocele. Urethrocele is the bulging of the anterior vaginal wall into the urethra. Cystocele is the herniation of the bladder wall into the vaginal vault. Pelvic prolapse is bulging of the cervix into the vaginal vault. Enterocele is herniation of the bowel into the posterior vaginal wall. Rectocele is herniation of the rectum into the vaginal wall. These prolapses are graded depending on the degree of herniation.

The woman is asked to cough and perform a Valsalva maneuver to assess the urethra's system of muscular and ligament support. If urine leakage occurs, the index and middle

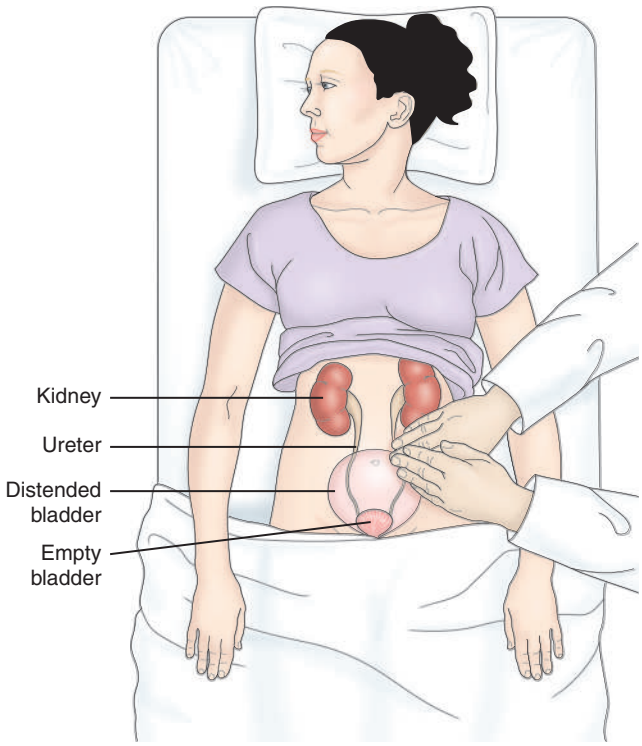


Figure 43-7 • Palpation of the bladder.

fingers of the examiner's gloved hand are used to support either side of the urethra as the woman is asked to repeat the Valsalva maneuver; this is called the *Marshall–Bonney maneuver.* If this produces urinary leakage, referral is suggested.

The patient is assessed for edema and changes in body weight. Edema may be observed, particularly in the face causing puffiness in the morning, which is an early symptom of renal dysfunction. Edema may be noted in the dependent parts of the body, such as the ankles and sacral areas, and suggests fluid retention. An increase in body weight commonly accompanies edema. A 1 kg weight gain equals approximately 1000 mL of fluid (Hall, 2016).

The deep tendon reflexes of the knee are examined for quality and symmetry. This is an important part of testing for neurologic causes of bladder dysfunction, because the sacral area, which innervates the lower extremities, is the same peripheral nerve area responsible for urinary continence. The gait pattern of the person with bladder dysfunction is also noted, as well as the patient's ability to walk toe to heel. These tests evaluate possible supra spinal causes for urinary incontinence.

Diagnostic Evaluation

A wide range of diagnostic studies may be performed in patients with urinary conditions. A comprehensive health history is used to determine the appropriate laboratory and diagnostic tests. The following sections review some of the specific tests that might be used.

The nurse educates the patient about the purpose, what to expect, and any possible side effects related to these examinations prior to testing. The nurse should also note trends in results, because they provide information about disease progression as well as the patient's response to therapy.

Most patients undergoing urologic testing or imaging studies are apprehensive, even those who have had these tests in the past. Patients frequently feel discomfort and embarrassment about such a private and personal function as voiding. Voiding in the presence of others can frequently cause guarding, a natural reflex that inhibits voiding due to situational anxiety. Because the outcomes of these studies determine the plan of care, the nurse must help the patient relax by providing as much privacy and explanation about the procedure as possible (see Chart 43-3). In addition, Chart 43-4 provides a plan of care for patients undergoing diagnostic testing.

Urinalysis and Urine Culture

The urinalysis provides important clinical information about kidney function and helps diagnose other diseases, such as diabetes. The urine culture determines whether bacteria are present in the urine, as well as their strains and concentration. Urine culture and sensitivity also identify the antimicrobial

Chart 43-3 PATIENT EDUCATION

Before and After Urodynamic Testing

The nurse instructs the patient on what to expect before, during, and after the procedure:

Preprocedure

- A physician or nurse will conduct an in-depth interview. Questions related to the urologic symptoms and voiding habits will be asked.

During the Procedure

- You will be asked to describe sensations felt.
- You might be asked to change positions (e.g., from supine to sitting or standing).
- You may be asked to cough or perform the Valsalva maneuver (bear down).
- You will probably need to have one or two urethral catheters inserted so that bladder pressure and bladder filling can be measured. Another catheter may be placed in the rectum or vagina to measure abdominal pressure.
- You may also have electrodes (surface, wire, or needle) placed in the perianal area for electromyography. This may be uncomfortable initially during insertion and later during position changes.
- Your bladder will be filled through the urethral catheter one or more times.

After the Procedure

- You may experience urinary frequency, urgency, or dysuria from the urethral catheters. Avoid caffeinated, carbonated, and alcoholic beverages because they can further irritate the bladder. These symptoms usually decrease or subside by the day after the procedure.
- You might notice slight hematuria (blood-tinged urine) right after the procedure (especially in men with benign prostatic hyperplasia). Drinking fluids will help to clear the hematuria.
- If the urinary meatus is irritated, a warm sitz bath may be helpful.
- Be alert to signs of a urinary tract infection. Contact your primary provider if you experience fever, chills, lower back pain, or continued dysuria and hematuria.
- If you receive an antibiotic medication before the procedure, you should continue taking the complete course of medication after the procedure. This is a measure to prevent infection.

Chart 43-4 PLAN OF NURSING CARE

Care of the Patient Undergoing Diagnostic Testing of the Renal–Urologic System

NURSING DIAGNOSIS: Deficient knowledge about procedures and diagnostic tests
GOAL: Patient demonstrates increased understanding of the procedure and tests and expected behaviors

Nursing Interventions	Rationale	Expected Outcomes
1. Assess patient's level of understanding of planned diagnostic tests	1. Provides basis for education and gives indication of patient's perception of tests	• States rationale for planned diagnostic tests and what tasks and behaviors are expected during the procedure
2. Provide a description of tests in language the patient can understand	2. Understanding what is expected enhances patient adherence and cooperation	• Adheres to prescribed urine collection, fluid modifications, or other procedures required for diagnostic evaluation
3. Assess patient's understanding of test results after their completion	3. Apprehension may interfere with patient's ability to understand information and results provided by health care team	• Restates in own words results of diagnostic tests
4. Reinforce information provided to patient about test results and implications for follow-up care	4. Provides opportunity for patient to clarify information and anticipate follow-up care	• Asks for clarification of terms and procedures • Explains rationale for follow-up care • Participates in follow-up care

NURSING DIAGNOSIS: Acute pain related to infection, edema, obstruction, or bleeding along urinary tract or related to invasive diagnostic tests
GOAL: Patient reports decrease in pain and absence of discomfort

Nursing Interventions	Rationale	Expected Outcomes
1. Assess level of pain: dysuria, burning on urination, abdominal or flank pain, bladder spasm	1. Provides baseline for evaluation of pain-relief strategies and progression of dysfunction	• Reports decreasing levels of pain • Reports absence of local symptoms
2. Encourage fluid intake (unless contraindicated)	2. Promotes dilute urine and flushing of the lower urinary tract	• States ability to start and stop urinary stream without discomfort • Consumes increased fluid intake if indicated
3. Encourage warm sitz baths	3. Relieves local discomfort and promotes relaxation	• Uses sitz bath as indicated
4. Report increased pain to primary provider	4. May indicate progression or recurrence of dysfunction, or untoward signs (e.g., bleeding, calculi)	• Identifies signs and symptoms to be reported to the primary provider • Takes medications as prescribed
5. Administer analgesic and antispasmodic agents for pain and spasm as prescribed	5. Prescribed to relieve pain or spasm	• Does not delay in emptying bladder • Uses appropriate hygienic measures, avoids bubble baths, uses appropriate hygiene after bowel movements
6. Assess voiding patterns and hygiene practices and provide instructions about recommended voiding patterns and hygienic practices	6. Delayed emptying of the bladder and poor hygiene may contribute to pain secondary to renal or urinary tract dysfunction	

NURSING DIAGNOSIS: Fear related to potential alteration in renal function and embarrassment secondary to discussion of urinary function and invasion of genitalia
GOAL: Patient appears relaxed and reports decreased fear and anxiety

Nursing Interventions	Rationale	Expected Outcomes
1. Assess patient's level of fear and apprehension	1. A high level of fear or apprehension can interfere with learning and cooperation	• Appears relaxed with a low level of fear or apprehension
2. Explain all procedures and tests to patient	2. Knowledge about what is expected helps reduce fear and apprehension	• States rationale for tests and procedures in a calm, relaxed manner
3. Provide privacy and respect patient's modesty by closing doors and keeping patient covered. Keep urinal and bedpan covered and out of sight	3. Communicates that you are aware of and accept patient's need for privacy and modesty	• Maintains usual privacy and modesty • Discusses own urinary tract dysfunction using correct terminology without overt indications of embarrassment or discomfort
4. Use correct terminology in a factual manner when questioning patient about urinary tract dysfunction	4. Conveys that you are comfortable discussing patient's urinary dysfunction and symptoms with patient	• Relates fears and concerns
5. Assess patient's fears about perceived changes associated with tests and other procedures	5. May uncover fears and misconceptions of the patient that can be alleviated by correct understanding	• Demonstrates correct understanding of procedures and possible outcomes
6. Instruct patient in relaxation techniques	6. Promotes relaxation and assists patient in coping with uncertainty about outcomes	• Appears relaxed with low level of fear and apprehension

therapy that is best suited for the particular strains identified, taking into consideration the antibiotic agents that have the best rate of resolution in that particular geographic region. To get accurate results in urine culture test, the first morning sample collected from the midstream is the most valuable. Before collection of specimen the nurse needs to instruct the patient to clean the urinary meatus. The patient should be instructed to leave the first and last part of urine and collect the midportion without touching the lid or surface of the sterile urine collection container. Appropriate physical evaluation of urine for any abnormality can assist in detecting serious underlying diseases.

Components

Urine examination includes the following:

- Urine color (see Table 43-4)
- Urine clarity and odor
- Urine pH and specific gravity
- Tests to detect protein, glucose, and ketone bodies in the urine (proteinuria, renal glycosuria, and ketonuria, respectively)
- Microscopic examination of the urine sediment after centrifugation to detect RBCs (hematuria), white blood cells (pyuria), casts (cylindruria), crystals (crystalluria), and bacteria (bacteriuria) (see Table 43-3)

Researchers are working on additional noninvasive tests that can be performed on urine to detect conditions such as bladder cancer. For example, urine telomerase activity levels have been found to be sensitive and specific to detect bladder cancer in men (Lamarca & Barriuso, 2012).

Significance of Findings

Several abnormalities, such as hematuria and proteinuria, produce no symptoms but may be detected during a routine urinalysis using a dipstick. Normally, about 1 million RBCs pass into the urine daily, which is equivalent to one to three RBCs per high-power field. Hematuria (more than three RBCs per high-power field) can develop from an abnormality anywhere along the genitourinary tract and is more common in women than in men. Common causes include acute infection (cystitis, urethritis, or prostatitis), renal calculi, and neoplasm. Other causes include systemic disorders, such as bleeding disorders; malignant lesions; and medications, such as warfarin (Coumadin) and heparin. Although hematuria may initially be detected using a dipstick test, further evaluation is necessary with a 24-hour collection (Fischbach & Dunning, 2015).

Proteinuria may be a benign finding, or it may signify serious disease. Occasional loss of up to 150 mg/day of protein in the urine, primarily albumin and Tamm–Horsfall protein (also known as uromodulin), is considered normal and usually does not require further evaluation. A dipstick examination, which can detect from 30 to 1000 mg/dL of protein, should be used as a screening test only, because urine concentration, pH, hematuria, and radiocontrast materials all affect the results. Because dipstick analysis does not detect protein concentrations of less than 30 mg/dL, the test cannot be used for early detection of diabetic nephropathy. Microalbuminuria (excretion of 20 to 200 mg/dL of protein in the urine) is an early sign of diabetic nephropathy. Common benign causes of transient proteinuria are fever, strenuous exercise, and prolonged standing.

Causes of persistent proteinuria include glomerular diseases, malignancies, collagen diseases, diabetes, preeclampsia, hypothyroidism, heart failure, exposure to heavy metals, and the use of medications, such as nonsteroidal anti-inflammatory drugs and angiotensin-converting enzyme inhibitors (Comerford, 2015).

TABLE 43-4 Changes in Urine Color and Possible Causes

Urine Color	Possible Cause
Colorless to pale yellow	Dilute urine due to diuretic agents, alcohol consumption, diabetes insipidus, glycosuria, excess fluid intake, kidney disease
Yellow to milky white	Pyuria, infection, vaginal cream
Bright yellow	Multiple vitamin preparations
Pink to red	Hemoglobin breakdown, red blood cells, gross blood, menses, bladder or prostate surgery, beets, blackberries, medications (phenytoin [Dilantin], rifampin [Rifadin], thioridazine [Mellaril], cascara sagrada, senna products)
Blue, blue green	Dyes, methylene blue, *Pseudomonas* species organisms, medications (amitriptyline HCl [Amitriptyline], triamterene [Dyrenium])
Orange to amber	Concentrated urine due to dehydration, fever, bile, excess bilirubin or carotene, medications (phenazopyridine hydrochloride [Pyridium], nitrofurantoin [Furadantin])
Brown to black	Old red blood cells, urobilinogen, bilirubin, melanin, porphyrin, extremely concentrated urine due to dehydration, medications (cascara sagrada, metronidazole [Flagyl], iron preparations, quinine sulfate [Qualaquin], senna products, methyldopa [Aldomet], nitrofurantoin)

Specific Gravity

Specific gravity is an expression of the degree of concentration of the urine that measures the density of a solution compared to the density of water, which is 1.000. Specific gravity is altered by the presence of blood, protein, and casts in the urine. The normal range of urine-specific gravity is 1.010 to 1.025 (Grossman & Porth, 2014).

Methods for determination of specific gravity include the following:

- Multiple-test dipstick (most common method), with a specific reagent area for specific gravity
- Urinometer (least accurate method), in which urine is placed in a small cylinder and the urinometer is floated in the urine; a specific gravity reading is obtained at the meniscus level of the urine
- Refractometer, an instrument used in a laboratory setting, which measures differences in the speed of light passing through air and the urine sample; this is the most accurate test

Urine-specific gravity depends largely on hydration status. When fluid intake decreases, specific gravity normally increases. With high fluid intake, specific gravity decreases. In patients with kidney disease, urine-specific gravity does not vary with fluid intake, and the patient's urine is said to have a fixed specific gravity. Disorders or conditions that cause decreased urine-specific gravity include diabetes insipidus, glomerulonephritis, and severe renal damage. Those that can cause increased specific gravity include diabetes, nephritis, and fluid deficit.

Osmolality

Osmolality is the most accurate measurement of the kidney's ability to dilute and concentrate urine. It measures the number of solute particles in a kilogram of water. Serum and

urine osmolality are measured simultaneously to assess the body's fluid status. In healthy adults, serum osmolality is 280 to 300 mOsm/kg, and normal urine osmolality is 200 to 800 mOsm/kg. For a 24-hour urine sample, the normal value is 300 to 900 mOsm/kg (Fischbach & Dunning, 2015).

Renal Function Tests

Renal function tests are used to evaluate the severity of kidney disease and to assess the status of the patient's kidney function. These tests also provide information about the effectiveness of the kidney in carrying out its excretory function. Renal function test results may be within normal limits until the GFR is reduced to less than 50% of normal. Renal function can be assessed most accurately if several tests are performed and their results are analyzed together. Common tests of renal function include renal concentration tests, creatinine clearance, and serum creatinine and blood urea nitrogen (end product of protein metabolism) levels (see Table 43-5).

Other tests for evaluating renal function that may be helpful include serum electrolyte levels as well as urinary biomarkers to detect acute kidney injury (Fallone & Cotton, 2015) (see Chapter 7).

Diagnostic Imaging

Kidney, Ureter, and Bladder Studies

An x-ray study of the abdomen or kidneys, ureters, and bladder (KUB) may be performed to delineate the size, shape, and position of the kidneys and to reveal urinary system abnormalities (Fischbach & Dunning, 2015).

General Ultrasonography

Ultrasonography is a noninvasive procedure that uses sound waves passed into the body through a transducer to detect abnormalities of internal tissues and organs. Abnormalities such as fluid accumulation, masses, congenital malformations, changes in organ size, and obstructions can be identified. During the test, the lower abdomen and genitalia may need to be exposed. Ultrasonography requires a full bladder; therefore, fluid intake is encouraged before the procedure.

Bladder Ultrasonography

Bladder ultrasonography is a noninvasive method of measuring urine volume in the bladder. It may be indicated for urinary frequency, inability to void after removal of an indwelling urinary catheter, measurement of postvoiding residual urine volume, inability to void postoperatively, or assessment of the need for catheterization during the initial stages of an intermittent catheterization training program. Portable, battery-operated devices are available for bedside use. The scan head is placed on the patient's abdomen and directed toward the bladder (see Fig. 43-8). The device automatically calculates and displays urine volume.

Computed Tomography and Magnetic Resonance Imaging

Computed tomography (CT) and magnetic resonance imaging (MRI) are noninvasive techniques that provide excellent cross-sectional views of the anatomy of the kidney and urinary tract. They are used to evaluate genitourinary masses, nephrolithiasis, chronic renal infections, renal or urinary tract trauma,

TABLE 43-5 Renal Function Tests

Test	Purpose	Normal Values
Renal Concentration		
Specific gravity	A measure of the degree of concentration of the urine.	1.010–1.025
Urine osmolality	Concentrating ability is lost early in kidney disease; hence, these test findings may disclose early defects in renal function.	250–900 mOsm/kg/24 hr, 50–1200 mOsm/kg random sample
24-Hour Urine		
Creatinine clearance	Detects and evaluates progression of kidney disease. Test measures volume of blood cleared of endogenous creatinine in 1 minute, which provides an approximation of the glomerular filtration rate. Sensitive indicator of kidney disease used to follow progression of kidney disease.	Measured in mL/min/1.73 m^2

Age (Years)	Male	Female
<30	88–146	81–134
30–40	82–140	75–128
40–50	75–133	69–122
50–60	68–126	64–116
60–70	61–120	58–110
70–80	55–113	52–105

Serum		
Creatinine level	Measures effectiveness of renal function. Creatinine is the end product of muscle energy metabolism. In normal function, the level of creatinine, which is regulated and excreted by the kidneys, remains fairly constant in the body.	0.6–1.2 mg/dL (50–110 mmol/L)
BUN	Serves as index of renal function. Urea is the nitrogenous end product of protein metabolism. Test values are affected by protein intake, tissue breakdown, and fluid volume changes.	7–18 mg/dL; patients >60 years: 8–20 mg/dL
BUN-to-creatinine ratio	Evaluates hydration status. An elevated ratio is seen in hypovolemia; a normal ratio with an elevated BUN and creatinine is seen with intrinsic kidney disease.	About 10:1

BUN, blood urea nitrogen.

Adapted from Fischbach, F., & Dunning, M. B. (2015). A manual of laboratory and diagnostic tests (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.



Figure 43-8 • Bladder ultrasonography.

metastatic disease, and soft tissue abnormalities. Occasionally, an oral or intravenous (IV) radiopaque contrast agent is used in CT scanning to enhance visualization.

Nursing Interventions

Preparation includes educating the patient about relaxation techniques and explaining that they will be able to communicate with the staff by means of a microphone located inside the scanner. Many MRI suites provide headphones so that patients can listen to the music of their choice during the procedure. Nursing care guidelines for patient preparation and precautions for any imaging procedure that requires a contrast agent (contrast medium) are explained in Chart 43-5.

Before the patient enters the room where the MRI is to be performed, all metal objects and credit cards (the magnetic field can erase them) are removed. This includes medication patches (e.g., nicotine and nitroglycerin) that have a metal backing, which can cause burns if they are not removed. No metal objects (e.g., oxygen tanks, ventilators, stethoscopes) may be brought into the MRI room. The magnetic field is so strong that any metal-containing items will be pulled toward the magnet, causing severe injury and possible death. A patient history is obtained to determine the presence of any metal objects (e.g., aneurysm clips, orthopedic hardware, pacemakers, artificial heart valves, intrauterine devices). These objects could malfunction, be dislodged, or heat up as they absorb energy. Cochlear implants are inactivated by MRI; therefore, other imaging procedures are considered. A sedative agent may be prescribed, because claustrophobia is a problem for some patients.

Chart 43-5

Patient Care During Urologic Testing with Contrast Agents

For some patients, contrast agents are nephrotoxic and allergenic. Emergency equipment and medications should be available in case of an anaphylactic reaction to the contrast agent. Emergency supplies include epinephrine, corticosteroids, vasopressors, oxygen, and airway and suction equipment.

The following guidelines can help the nurse respond quickly in the event of a problem.

Nursing Actions for Patient Preparation

- Obtain the patient's allergy history with emphasis on allergy to iodine, shellfish, and other seafood, because many contrast agents contain iodine.
- Notify primary provider and radiologist if the patient is allergic or suspected to be allergic to iodine.
- Obtain health history. Contrast agents should be used with great caution in older patients and in patients who have multiple myeloma, renal impairment, or volume depletion.
- Obtain medication history. Nephrotoxic medications such as vancomycin, amphotericin B, metformin, and nonsteroidal anti-inflammatory drugs should be discontinued before contrast media administration.
- The use of both nonionic low-osmolar contrast media (LOCM, e.g., iohexol) and ionic high-osmolar contrast media (HOCM, e.g., diatrizoate), is indicated in patients with renal impairment and other risk factors to prevent contrast-induced nephropathy.
- Check kidney function in at-risk patients. Patients should receive IV hydration prior to the procedure.
- Inform the patient that they may experience a temporary feeling of warmth, flushing of the face, and an unusual flavor (similar to that of seafood) in the mouth when the contrast agent is infused.

Nursing Actions During and Post Procedure

- Monitor patient closely for allergic reaction, and monitor urine output.
- Maintain hydration status.

Adapted from Andreucci, M., Solomon, R., & Tasanarong, A. (2014). Side effects of radiographic contrast media: Pathogenesis, risk factors, and prevention. Retrieved on 4/17/2016 at: www.hindawi.com/journals/bmri/2014/741018/; Rank, W. (2013). Preventing contrast media–induced nephrotoxicity. Nursing, 43(4), 48–51.

Prior to MRI of the urinary system, the patient needs to be informed to avoid alcohol, caffeine-containing beverages, and smoking for at least 2 hours and food for at least 1 hour prior to the scan. Patients should continue taking their usual medication, except for iron supplements, which can interfere with the imaging (Fischbach & Dunning, 2015).

Nuclear Scans

Nuclear scans require injection of a radioisotope (a technetium 99m–labeled compound or iodine 123 [^{123}I] hippurate) into the circulatory system; the isotope is then monitored as it moves through the blood vessels of the kidneys. A scintillation camera is placed behind the kidney with the patient in a supine, prone, or seated position. Hypersensitivity to the radioisotope is rare. The technetium scan provides information about kidney perfusion. The ^{123}I-hippurate renal scan provides information about kidney function, such as GFR.

Nuclear scans are used to evaluate acute and chronic kidney injury, renal masses, and blood flow before and after kidney transplantation. The radioisotope is injected at a specified time to achieve the proper concentration in the kidneys. After the

procedure is completed, the patient is encouraged to drink fluids to promote excretion of the radioisotope by the kidneys.

Intravenous Urography

IV urography includes various tests such as excretory urography, intravenous pyelography (IVP), and infusion drip pyelography. A radiopaque contrast agent is given IV. An IVP shows the kidneys, ureter, and bladder via x-ray imaging as the dye moves through the upper and then the lower urinary system. A nephrotomogram may be carried out as part of the study to visualize different layers of the kidney and the diffuse structures within each layer and to differentiate solid masses or lesions from cysts in the kidneys or urinary tract.

IV urography may be used as the initial assessment of many suspected urologic conditions, especially lesions in the kidneys and ureters. It also provides an approximate estimate of renal function. After the contrast agent (sodium diatrizoate or meglumine diatrizoate) is given IV, multiple x-rays are obtained to visualize drainage structures in the upper and lower urinary systems.

Infusion drip pyelography requires IV infusion of a large volume of a dilute contrast agent to opacify the renal parenchyma and fills the urinary tract. This examination method is useful when prolonged opacification of the drainage structures is desired so that tomograms (body-section radiography) can be made. Images are obtained at specified intervals after the start of the infusion. These images show the filled and distended collecting system. The patient preparation is the same as for excretory urography, except fluids are not restricted.

Retrograde Pyelography

In retrograde pyelography, catheters are advanced through the ureters into the renal pelvis by means of cystoscopy. A contrast agent is then injected. Retrograde pyelography is usually performed if IV urography provides inadequate visualization of the collecting systems. It may also be used before extracorporeal shock wave lithotripsy and in patients with urologic cancer who need follow-up and have an allergy to IV contrast agents. Possible complications include infection, hematuria, and perforation of the ureter. Retrograde pyelography is used infrequently because of improved techniques in excretory urography.

Cystography

Cystography aids in evaluating vesicoureteral reflux (backflow of urine from the bladder into one or both ureters) and in assessing for bladder injury. A catheter is inserted into the bladder, and a contrast agent is instilled to outline the bladder wall. The contrast agent may leak through a small bladder perforation stemming from bladder injury, but such leakage is usually harmless. Cystography can also be performed with simultaneous pressure recordings inside the bladder.

Voiding Cystourethrography

Voiding cystourethrography uses fluoroscopy to visualize the lower urinary tract and assess urine storage in the bladder. It is commonly used as a diagnostic tool to identify vesicoureteral reflux. A urethral catheter is inserted, and a contrast agent is instilled into the bladder. When the bladder is full and the patient feels the urge to void, the catheter is removed, and the patient voids.

Renal Angiography

A renal angiogram, or renal arteriogram, provides an image of the renal arteries. The femoral (or axillary) artery is pierced with a needle, and a catheter is threaded up through the femoral and iliac arteries into the aorta or renal artery. A contrast agent is injected to opacify the renal arterial supply. Angiography is used to evaluate renal blood flow in suspected renal trauma, to differentiate renal cysts from tumors, and to evaluate hypertension. It is used preoperatively for renal transplantation.

Nursing Interventions

Before the procedure, a laxative may be prescribed to evacuate the colon so that unobstructed x-rays can be obtained. Injection sites (groin for femoral approach or axilla for axillary approach) may be shaved. The peripheral pulse sites (radial, femoral, and dorsalis pedis) are marked for easy access during postprocedural assessment (Rank, 2013). See Chart 43-5 for considerations for the patient receiving a contrast agent.

After the procedure, vital signs are monitored until stable. If the axillary artery was the injection site, blood pressure measurements are taken on the opposite arm. The injection site is examined for swelling and hematoma. Peripheral pulses are palpated, and the color and temperature of the involved extremity are noted and compared with those of the uninvolved extremity. Cold compresses may be applied to the injection site to decrease edema and pain. Possible complications include hematoma formation, arterial thrombosis or dissection, false aneurysm formation, and altered renal function.

MAG3 Renogram

This scan is used to further evaluate kidney function in some centers by permitting visualization of renal clearance (Fischbach & Dunning, 2015). The patient is given an injection containing a small amount of radioactive material, which will show how the kidneys are functioning. The patient needs to lie still for about 35 minutes while special cameras take images (Fischbach & Dunning, 2015).

Urologic Endoscopic Procedures

Endourology, or urologic endoscopic procedures, can be performed in one of two ways: using a cystoscope inserted into the urethra, or percutaneously, through a small incision.

The cystoscopic examination is used to directly visualize the urethra and bladder. The cystoscope, which is inserted through the urethra into the bladder, has an optical lens system that provides a magnified, illuminated view of the bladder (see Fig. 43-9). The use of high-intensity light and interchangeable lenses allows excellent visualization and permits still and motion pictures to be taken. The cystoscope is manipulated to allow complete visualization of the urethra and bladder as well as the ureteral orifices and prostatic urethra. Small ureteral catheters can be passed through the cystoscope for assessment of the ureters and the pelvis of each kidney.

The cystoscope also allows the urologist to obtain a urine specimen from each kidney to evaluate its function. Cup forceps can be inserted through the cystoscope for biopsy. Calculi may be removed from the urethra, bladder, and ureter using cystoscopy. If a lower tract cystoscopy is performed, the patient is usually conscious, and the procedure is usually no more uncomfortable than a catheterization. To minimize posttest urethral discomfort, viscous lidocaine is given several minutes before the study. If the cystoscopy includes examination of the upper tracts, a sedative agent may be given before the procedure. General anesthesia is usually given to ensure that there are no involuntary muscle spasms when the scope is being passed through the ureters or kidneys.

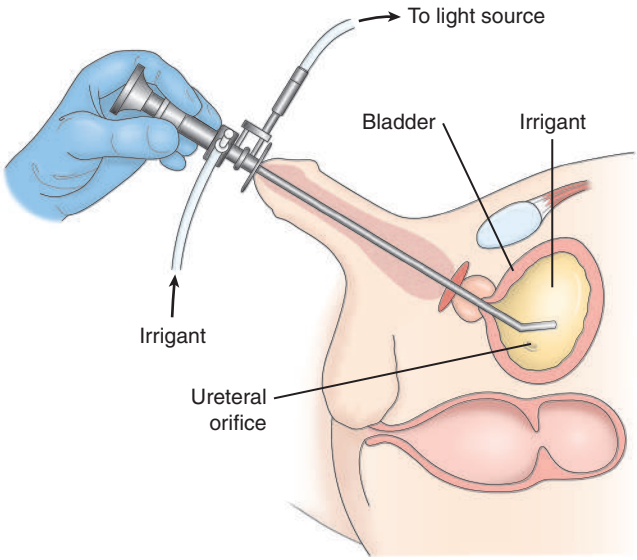


Figure 43-9 • Cystoscopic examination. A rigid or semirigid cystoscope is introduced into the bladder. The upper cord is an electric line for the light at the distal end of the cystoscope. The lower tubing leads from a reservoir of sterile irrigant that is used to inflate the bladder.

Nursing Interventions

The nurse describes the procedure to the patient and family to prepare them and to allay their fears. If an upper cystoscopy is to be performed, the patient is usually restricted to nothing by mouth (NPO) for several hours beforehand.

Postprocedural management is directed at relieving any discomfort resulting from the examination. Some burning on voiding, blood-tinged urine, and urinary frequency from trauma to the mucous membranes can be expected. Moist heat to the lower abdomen and warm sitz baths are helpful in relieving pain and relaxing the muscles.

After a cystoscopic examination, the patient with obstructive pathology may experience urine retention if the instruments used during the examination caused edema. The nurse carefully monitors the patient with prostatic hyperplasia for urine retention. Warm sitz baths and antispasmodic medication, such as flavoxate (Urispas), may be prescribed to relieve temporary urine retention caused by poor relaxation of the urinary sphincter; however, intermittent catheterization may be necessary for a few hours after the examination. The nurse monitors the patient for signs and symptoms of urinary tract infection. Because edema of the urethra secondary to local trauma may obstruct urine flow, the patient is also monitored for signs and symptoms of obstruction.

Biopsy

Renal and Ureteral Brush Biopsy

Brush biopsy techniques provide specific information when abnormal x-ray findings of the ureter or renal pelvis raise questions about whether a defect is a tumor, a stone, a blood clot, or an artifact. First, a cystoscopic examination is conducted. Then, a ureteral catheter is introduced, followed by a biopsy brush that is passed through the catheter. The suspected lesion is brushed back and forth to obtain cells and surface tissue fragments for histologic analysis.

Kidney Biopsy

Biopsy of the kidney is used to help diagnose and evaluate the extent of kidney disease. Indications for biopsy include unexplained acute kidney injury, persistent proteinuria or hematuria, transplant rejection, and glomerulopathies. A small section of renal cortex is obtained either percutaneously (needle biopsy) or by open biopsy through a small flank incision. Before the biopsy is carried out, coagulation studies are conducted to identify any risk of post biopsy bleeding. Contraindications to kidney biopsy include bleeding tendencies, uncontrolled hypertension, sepsis, a solitary kidney, large polycystic kidneys, kidney neoplasm, urinary tract infection, and morbid obesity (Doss-McQuitty, 2015).

The patient may be prescribed a fasting regimen 6 to 8 hours before the test. An IV line is established. A urine specimen is obtained and saved for comparison with the post biopsy specimen.

If a needle biopsy is to be performed, the patient is instructed to breathe in and hold that breath (to prevent the kidney from moving) while the needle is being inserted. The sedated patient is placed in a prone position with a sandbag under the abdomen. The skin at the biopsy site is infiltrated with a local anesthetic agent. The biopsy needle is introduced just inside the renal capsule of the outer quadrant of the kidney. The location of the needle may be confirmed by fluoroscopy or by ultrasound, in which case a special probe is used.

With open biopsy, a small incision is made over the kidney, allowing direct visualization. Preparation for an open biopsy is similar to that for any major abdominal surgery.

Nursing Interventions

After a biopsy procedure, nursing care includes monitoring vital signs for the first 24 hours to detect signs and symptoms of bleeding or infection. The nurse should assess for other signs and symptoms of internal bleeding such as pallor, dizziness, and flank or back pain. IV fluids may be given to help clear the kidneys and prevent clot formation. Urine may contain blood (usually clearing in 24 to 48 hours) from oozing at the site. Bed rest should be maintained and pressure dressings applied for prescribed periods of time to control bleeding. Puncture sites should be examined for signs and symptoms of infection. Analgesic agents should be given as prescribed and needed for pain (Doss-McQuitty, 2015).

CRITICAL THINKING EXERCISES

1. A patient you are caring for complains of urinary incontinence. Describe the assessment techniques appropriate to evaluate the patient. Review the possible causes and describe the actions you would take and the rationale for each action. Describe any differences in your assessments and possible action that are dependent on the gender of the patient.
2. A 30-year-old male is admitted to the emergency department for evaluation of urinary dysfunction and is scheduled for a renal angiography. The patient is now highly anxious. Describe your priorities for educating this patient about a kidney biopsy. What are your priority interventions for decreasing the patient's anxiety?
3. You make a home visit to a 70-year-old female who had a urologic examination with contrast. She complains of flu-like symptoms and reports that she thinks she notices swelling in her lower extremities. She has a history of renal impairment. Identify assessments and possible interventions that you would use to evaluate and manage the patient's symptoms. Identify the evidence for the assessments and nursing interventions you chose and the strength of that evidence.

REFERENCES

Books

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Doss-McQuitty, S. J. (2015). Assessment of kidney structure and function. In C. S. Counts (Ed.): Core curriculum for nephrology nursing (6th ed.). Pitman, NJ: American Nephrology Nurses' Association.

Eaton, D. C., & Pooler, J. P. (2013). Vander's renal physiology (8th ed.). New York: McGraw-Hill Education.

Eliopoulos, C. (2018). Gerontological nursing (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Fallone, S., & Cotton, A. B. (2015). Acute kidney injury. In C. S. Counts (Ed.): Core curriculum for nephrology nursing (6th ed.). Pitman, NJ: American Nephrology Nurses' Association.

Fischbach, F., & Dunning, M. B. (2015). A manual of laboratory and diagnostic tests (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Grossman, S., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Hall, J. E. (2016). Guyton and Hall textbook of medical physiology (13th ed.). Philadelphia, PA: Elsevier.

Headly, C. M. (2015). Anatomy and physiology. In C. S. Counts (Ed.): Core curriculum for nephrology nursing (6th ed.). Pitman, NJ: American Nephrology Nurses' Association.

Johnson. C., Praveen. D., Pope. A., Raj. T. S., Pillai. R. N., Land. M. A., & Neal. B. (2017). Mean population salt consumption in India: A systematic review. Journal of Hypertension, 35(1), 3–9.

Porth, C. M., & Matfin, G. (2009). Pathophysiology: Concepts of altered health states (8th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Skorecki, K., Chertow, G., Marsden P. A., et al. (2015). Brenner and Rector's the kidney (10th ed.). Philadelphia, PA: Elsevier Saunders.

Springhouse. (2008). Lippincott's visual encyclopedia of clinical skills. Philadelphia, PA: Lippincott Williams & Wilkins.

Weber, J. R., & Kelley, J. H. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

Andreucci, M., Solomon, R., & Tasanarong, A. (2014). Side effects of radiographic contrast media: pathogenesis, risk factors, and prevention. *BioMed Research International.* Retrieved on 4/17/2016 at: www.hindawi.com/journals/bmri/2014/741018/

Davis, C., Chrisman, J., & Walden, P. (2012). To scan or not to scan? Detecting urinary retention. Nursing Made Incredibly Easy, 10(4), 36–54.

Lamarca, A., & Barriuso, J. (2012). Urine telomerase for diagnosis and surveillance of bladder cancer. *Advances in Urology.* Retrieved on 12/29/15 at: www.hindawi.com/journals/au/2012/693631

Rank, W. (2013). Preventing contrast media–induced nephrotoxicity. Nursing, 43(4), 48–51.

Resources

National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, www.niddk.nih.gov

National Kidney Foundation India-NKFI, http://www.nkfi.in/

CHAPTER 44

Management of Patients with Kidney Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe the key factors associated with the development of kidney disorders.
2. Differentiate between the causes of chronic kidney disease (CKD) and acute kidney injury (AKI).
3. Explain the pathophysiology, clinical manifestations, medical management, and nursing management for patients with kidney disorders.
4. Understand the nursing management of patients with chronic kidney disease and acute kidney injury.
5. Compare and contrast the renal replacement therapies, including hemodialysis, peritoneal dialysis, continuous renal replacement therapies, and kidney transplantation.
6. Identify the nursing management of the patient on dialysis who is hospitalized.
7. Develop a postoperative plan of nursing care for the patient undergoing kidney surgery and transplantation.

GLOSSARY

arteriovenous graft: type of surgically created vascular access for dialysis by which a piece of biologic, semibiologic, or synthetic graft material connects the patient's artery to a vein
azotemia: abnormal concentration of nitrogenous waste products in the blood
chronic kidney disease: kidney damage or a decrease in the glomerular filtration rate lasting for 3 or more months
continuous ambulatory peritoneal dialysis (CAPD): method of peritoneal dialysis whereby a patient manually performs exchanges or cycles throughout the day
continuous cyclic peritoneal dialysis (CCPD): method of peritoneal dialysis in which a peritoneal dialysis machine (cycler) automatically performs exchanges, usually while the patient sleeps
continuous renal replacement therapy (CRRT): method used to replace normal kidney function in patients who are hemodynamically unstable by circulating the patient's blood through a hemofilter and returning it to the patient
dialysate: the electrolyte solution that circulates through the dialyzer in hemodialysis and through the peritoneal membrane in peritoneal dialysis
dialyzer: artificial kidney; contains a semipermeable membrane through which particles of a certain size can pass
diffusion: movement of solutes (waste products) from an area of higher concentration to an area of lower concentration
effluent: term used to describe the drained fluid from a peritoneal dialysis exchange
end-stage kidney disease (ESKD): final stage of chronic kidney disease that results in retention of uremic waste products and the need for renal replacement therapies
exchange: denotes a complete cycle including fill, dwell, and drain phases of peritoneal dialysis
glomerular filtration rate (GFR): amount of plasma filtered through the glomeruli per unit of time
glomerulonephritis: inflammation of the glomerular capillaries
hemodialysis: procedure during which a patient's blood is circulated through a dialyzer to remove waste products and excess fluid
interstitial nephritis: inflammation within the renal tissue
nephrosclerosis: hardening of the renal arteries
nephrotic syndrome: type of kidney disease with increased glomerular permeability and massive proteinuria
nephrotoxic: any substance, medication, or action that destroys kidney tissue
oliguria: urine output less than 0.5 mL/kg/hr
osmosis: movement of water through a semipermeable membrane from an area of lower solute concentration to an area of higher solute concentration
peritoneal dialysis: procedure that uses the lining of the patient's peritoneal cavity as the semipermeable membrane for exchange of fluid and solutes
peritonitis: inflammation of the peritoneal membrane (lining of the peritoneal cavity)
polyuria: excessive urine production
ultrafiltration: process whereby water is removed from the blood by means of a pressure gradient between the patient's blood and the dialysate
uremia: an excess of urea and other nitrogenous wastes in the blood
urinary casts: proteins secreted by damaged kidney tubules

Introduction

The kidneys and urinary system help regulate the body's internal environment and are essential for the maintenance of life. Nurses working in any clinical setting may encounter patients with various kidney injuries and diseases, and thus need to be knowledgeable about these disorders. This chapter provides an overview of electrolyte imbalances and systemic manifestations that are common in patients with kidney disorders. The main causes are discussed, together with management strategies to prevent damage and preserve renal function. Chronic kidney disease (CKD) and acute kidney injury (AKI) are discussed, as is the care of patients with other renal conditions requiring dialysis, continuous renal replacement therapies (CRRTs), transplantation, and kidney surgery.

FLUID AND ELECTROLYTE IMBALANCES IN KIDNEY DISORDERS

Patients with kidney disorders commonly experience fluid and electrolyte imbalances and require careful assessment and close

monitoring for signs of potential problems. The patient whose fluid intake exceeds the ability of the kidneys to excrete fluid is said to have fluid overload. If fluid intake is inadequate, the patient is said to be volume depleted and may show signs and symptoms of fluid volume deficit. The intake and output (I&O) record, a key monitoring tool, is used to document important fluid parameters, including the amount of fluid taken in (orally or parenterally), the volume of urine excreted, and other fluid losses (diarrhea, vomiting, diaphoresis). Patient weight is also important, and documenting trends in weight is a key assessment strategy essential for determining the daily fluid allowance and indicating signs of fluid volume excess or deficit.

Nursing Alert: The most accurate indicator of fluid loss or gain in patients who are acutely ill is weight. An accurate daily weight must be obtained and recorded. 1-kg weight gain is equal to 1000 mL of retained fluid.

Clinical Manifestations

The signs and symptoms of common fluid and electrolyte disturbances that can occur in patients with kidney disorders and general management strategies are listed in Table 44-1. The nurse continually assesses, monitors, and informs appropriate members of the health care team if the patient exhibits any of these signs. Management strategies for fluid and electrolyte disturbances in kidney disease are discussed in greater depth later in this chapter (see Chapter 7).

Gerontologic Considerations

With aging, the kidney is less able to respond to acute fluid and electrolyte changes. Older adult patients may develop atypical and nonspecific signs and symptoms of altered renal function and fluid and electrolyte imbalances. A fluid balance deficit in older adults can lead to constipation, falls, medication toxicity, urinary tract and respiratory tract infections, delirium, seizures, electrolyte imbalances, hyperthermia, and delayed wound

TABLE 44-1 Common Fluid and Electrolyte Disturbances in Kidney Disorders

Disturbance	Manifestations	General Management Strategies
Fluid volume deficit	Acute weight loss ≥5%, decreased skin turgor, dry mucous membranes, oliguria or anuria, increased hematocrit, BUN level increased out of proportion to creatinine level, hypothermia	Fluid challenge, fluid replacement orally or parenterally
Fluid volume excess	Acute weight gain ≥5%, edema, crackles, shortness of breath, decreased BUN, decreased hematocrit, distended neck veins	Fluid and sodium restriction, diuretic agents, dialysis
Sodium deficit	Nausea, malaise, lethargy, headache, abdominal cramps, apprehension, seizures	Diet, normal saline or hypertonic saline solutions
Sodium excess	Dry, sticky mucous membranes, thirst, rough dry tongue, fever, restlessness, weakness, disorientation	Fluids, diuretic agents, dietary restriction
Potassium deficit	Anorexia, abdominal distention, paralytic ileus, muscle weakness, ECG changes, dysrhythmias	Diet, oral or parenteral potassium replacement therapy
Potassium excess	Diarrhea, colic, nausea, irritability, muscle weakness, ECG changes	Dietary restriction, diuretics, IV glucose, insulin and sodium bicarbonate, cation-exchange resin, calcium gluconate, dialysis
Calcium deficit	Abdominal and muscle cramps, stridor, carpopedal spasm, hyperactive reflexes, tetany, positive Chvostek or Trousseau sign, tingling of fingers and around mouth, ECG changes	Diet, oral or parenteral calcium salt replacement
Calcium excess	Deep bone pain, flank pain, muscle weakness, depressed deep tendon reflexes, constipation, nausea and vomiting, confusion, impaired memory, polyuria, polydipsia, ECG changes	Fluid replacement, etidronate, pamidronate, mithramycin, calcitonin, glucocorticoids, phosphate salts
Bicarbonate deficit	Headache, confusion, drowsiness, increased respiratory rate and depth, nausea and vomiting, warm flushed skin	Bicarbonate replacement, dialysis
Bicarbonate excess	Depressed respirations, muscle hypertonicity, dizziness, tingling of fingers and toes	Fluid replacement if volume depleted; ensure adequate chloride
Protein deficit	Chronic weight loss, emotional depression, pallor, fatigue, soft flabby muscles	Diet, dietary supplements, hyperalimentation, albumin
Magnesium deficit	Dysphagia, muscle cramps, hyperactive reflexes, tetany, positive Chvostek or Trousseau sign, tingling of fingers, dysrhythmias, vertigo	Diet, oral or parenteral magnesium replacement therapy
Magnesium excess	Facial flushing, nausea and vomiting, sensation of warmth, drowsiness, depressed deep tendon reflexes, muscle weakness, respiratory depression, cardiac arrest	Calcium gluconate, mechanical ventilation, dialysis
Phosphorus deficit	Deep bone pain, flank pain, muscle weakness and pain, paresthesia, apprehension, confusion, seizures	Diet, oral or parenteral phosphorus supplementation therapy

BUN, blood urea nitrogen; ECG, electrocardiographic; IV, intravenous.

healing. Recognition of acute changes in fluid and electrolytes is further hampered by their association with pre-existing disorders and the misconception that they are normal changes of aging.

KIDNEY DISORDERS

Chronic Kidney Disease

Chronic kidney disease is an umbrella term that describes kidney damage or a decrease in the glomerular filtration rate (GFR) lasting for 3 or more months. CKD is associated with decreased quality of life, increased health care expenditures, and premature death. Untreated CKD can result in end-stage kidney disease (ESKD), which is the final stage of CKD. ESKD results in retention of uremic waste products and the need for renal replacement therapies, dialysis, or kidney transplantation. Risk factors include cardiovascular disease, diabetes, hypertension, and obesity. Recent research reported that 10% of the U.S. population aged 20 years and older has CKD (Centers for Disease Control and Prevention [CDC], 2014).

Diabetes is the primary cause of CKD. More than 35% of the U.S. population aged 20 years and older with diabetes have CKD (CDC, 2014). Diabetes is the leading cause of kidney disease in patients starting renal replacement therapy. The second leading cause is hypertension, followed by glomerulonephritis and pyelonephritis; polycystic, hereditary, or congenital disorders; and renal cancers (U.S. Renal Data System [USRDS], 2015). More than 20% of the U.S. population aged 20 years and older with hypertension have CKD (CDC, 2014). With the increasing prevalence of diabetes and hypertension among Indians there is a concomitant increase in the prevalence of chronic renal failure and it is approximately estimated to be 6.3% (Varma, 2015). In India, there has been an alarming increase in the death rate attributable to renal failure; it has increased from 1.94% in 2000 to 3.04% in 2015 (Jha & Modi, 2017).

Pathophysiology

In the early stages of CKD, there can be significant damage to the kidneys without signs or symptoms. The damage to the kidneys is thought to be caused by prolonged acute inflammation that is not organ specific and thus has subtle systemic manifestations. Reduction in functional nephrons leads to derangements in kidney functions. The pathophysiology of chronic kidney disease is presented in Figure 44-1.

Clinical Manifestations

- Increased blood urea and serum creatinine level
- Edema starting as puffiness of face in the early morning and later bilateral pedal edema
- Weight gain
- Reduction in urine output
- Hiccoughs, nausea, vomiting, anorexia
- Breathing difficulty due to fluid overload
- Electrolyte abnormalities: Pulmonary crackles, ECG changes pertaining to hyperkalemia
- Renal osteodystrophy—osteoporosis of bones
- Anemia
- Pruritus due to deposition of urea in the skin

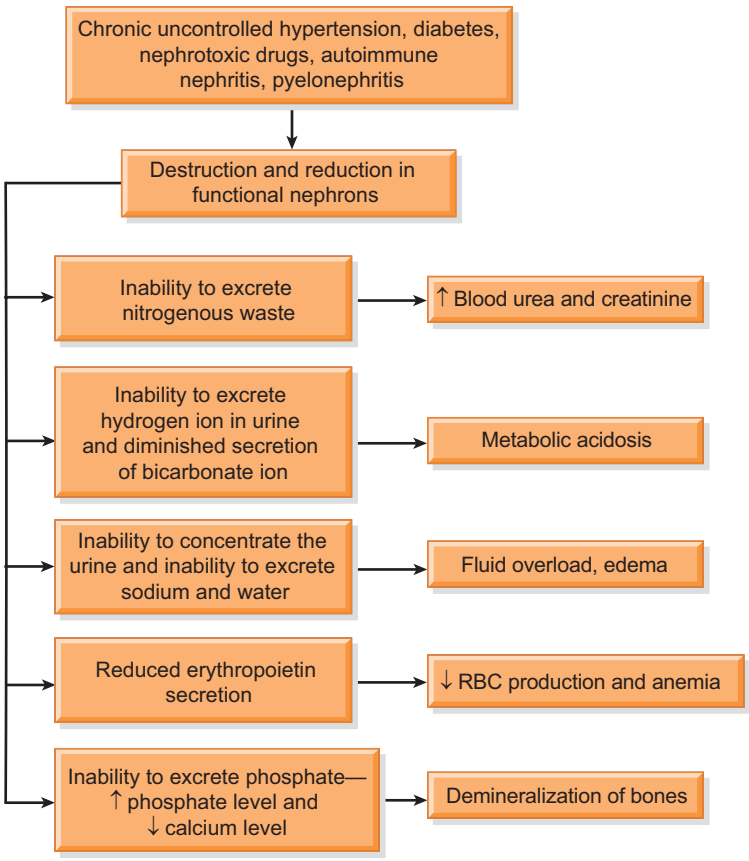


Figure 44-1 • Pathophysiology of chronic kidney disease.

Chart 44-1

Stages of Chronic Kidney Disease

Stages are based on the GFR. The normal GFR is 125 mL/min/1.73 m^2.

Stage 1

GFR ≥90 mL/min/1.73 m^2
Kidney damage with normal or increased GFR

Stage 2

GFR = 60–89 mL/min/1.73 m^2
Mild decrease in GFR

Stage 3

GFR = 30–59 mL/min/1.73 m^2
Moderate decrease in GFR

Stage 4

GFR = 15–29 mL/min/1.73 m^2
Severe decrease in GFR

Stage 5

GFR <15 mL/min/1.73 m^2
End-stage kidney disease or chronic kidney disease

GFR, glomerular filtration rate.

Adapted from Grossman, S. C., & Porth, C. M. (2014). Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Stages of Chronic Kidney Disease

CKD has been classified into five stages by the National Kidney Foundation (NKF) (see Chart 44-1). Stage 5 results when the kidneys cannot remove the body's metabolic wastes or perform their regulatory functions; thus, renal replacement therapies are required to sustain life. Screening and early intervention are important, because not all patients progress to stage 5 CKD. Patients with CKD are at increased risk for cardiovascular disease, which is the leading cause of morbidity and mortality (Kane-Gill, Sileanu, Murugan, et al., 2015). Treatment of hypertension, anemia, and hyperglycemia and detection of proteinuria all help to slow disease progression and improve patient outcomes (Lewis, 2013).

Assessment and Diagnostic Findings

The glomerular filtration rate (GFR) is the amount of plasma filtered through the glomeruli per unit of time. Creatinine clearance is a measure of the amount of creatinine the kidneys are able to clear in a 24-hour period. Normal values differ in men and women. Calculation of GFR, an important assessment parameter in CKD, is discussed in Chapter 43.

Medical Management

The management of patients with CKD includes treatment of the underlying causes. Regular clinical and laboratory assessment is important to keep the blood pressure below 130/80 mm Hg (Klein-Kauric, 2015). Medical management also includes early referral for initiation of renal replacement therapies as indicated by the patient's renal status. Prevention of complications is accomplished by controlling cardiovascular risk factors; treating hyperglycemia; managing anemia; smoking cessation, weight loss, and exercise programs as needed; and reduction in salt and alcohol intake.

Gerontologic Considerations

Changes in kidney function with normal aging increase the susceptibility of older patients to kidney dysfunction and kidney disease (Kane-Gill et al., 2015). As age advances, along with reduction of functional nephrons, tubulointerstitial changes and thickening of the basement membrane of the glomerular apparatus occurs (O'Sullivan et al., 2017). In addition, the incidence of systemic diseases, such as atherosclerosis, hypertension, heart failure, diabetes, and cancer, increases with advancing age, predisposing older adults to kidney disease associated with these disorders. Therefore, acute problems need to be prevented if possible or recognized and treated quickly to avoid kidney damage. Thus, nurses in all settings need to be alert to signs and symptoms of kidney dysfunction in older patients.

Older patients frequently take multiple prescription and over-the-counter medications. Because alterations in renal blood flow, glomerular filtration, and renal clearance increase the risk of medication-associated changes in renal function, precautions are indicated with all medications. When older patients undergo extensive diagnostic tests or when new medications (e.g., diuretic agents) are added, precautions must be taken to prevent dehydration, which can compromise marginal renal function and lead to kidney disease (Kane-Gill et al., 2015).

Nephrosclerosis

Nephrosclerosis (hardening of the renal arteries) is most often due to prolonged hypertension and diabetes. Nephrosclerosis is a major cause of CKD and ESKD secondary to many disorders.

Pathophysiology

There are two forms of nephrosclerosis: malignant (accelerated) and benign. Malignant nephrosclerosis is often associated with significant hypertension (diastolic blood pressure higher than 130 mm Hg). It usually occurs in young adults and twice as often in men compared to women (Klein-Kauric, 2015). Damage is caused by decreased blood flow to the kidney resulting in patchy necrosis of the renal parenchyma. Over time, fibrosis occurs and glomeruli are destroyed.

The disease process progresses rapidly. Without dialysis, more than half of patients die of uremia (an excess of urea and other nitrogenous waste products in the blood) in a few years. Benign nephrosclerosis can be found in older adults, associated with atherosclerosis and hypertension.

Assessment and Diagnostic Findings

Symptoms are rare early in the disease, even though the urine usually contains protein and occasional casts. Renal insufficiency and associated signs and symptoms occur late in the disease.

Medical Management

Treatment of nephrosclerosis is aggressive antihypertensive therapy. An angiotensin-converting enzyme (ACE) inhibitor, alone or in combination with other antihypertensive medications, significantly reduces its incidence. See Chapter 25 for additional information on hypertension.

Primary Glomerular Diseases

Diseases that destroy the glomerulus of the kidney are the third most common cause of stage 5 CKD. In these disorders, the glomerular capillaries are primarily involved. Antigen–antibody complexes form in the blood and become trapped in the glomerular capillaries (the filtering portion of the kidney), inducing an inflammatory response. Immunoglobulin G (IgG)—the major immunoglobulin (antibody) found in the blood—can be detected in the glomerular capillary walls. The major clinical manifestations of glomerular injury include proteinuria, hematuria, decreased GFR, decreased excretion of sodium, edema, and hypertension (see Chart 44-2).

Acute Nephritic Syndrome

Acute nephritic syndrome is a type of kidney disease with glomerular inflammation (Grossman & Porth, 2014). Glomerulonephritis is an inflammation of the glomerular capillaries that can occur in acute and chronic forms.

Pathophysiology

Primary glomerular diseases include postinfectious glomerulonephritis, rapidly progressive glomerulonephritis, membrane proliferative glomerulonephritis, and membranous glomerulonephritis. Postinfectious causes are group A beta-hemolytic streptococcal infection of the throat that precedes the onset of glomerulonephritis by 2 to 3 weeks (see Fig. 44-2). It may also follow impetigo (infection of the skin) and acute viral infections (upper respiratory tract infections, mumps, varicella zoster virus, Epstein–Barr virus, hepatitis B, and human immune deficiency virus [HIV] infection). In some patients, antigens outside the body (e.g., medications, foreign serum) initiate the process, resulting in antigen–antibody complexes being deposited in the glomeruli. In other patients, the kidney tissue itself serves as the inciting antigen.

Clinical Manifestations

The primary presenting features of an acute glomerular inflammation are hematuria, edema, azotemia (an abnormal concentration of nitrogenous wastes in the blood), and **proteinuria** (excess protein in the urine) (Grossman & Porth, 2014). The hematuria may be microscopic (identifiable only through microscopic examination) or macroscopic (visible to the eye). The urine may appear cola colored because of red blood cells (RBCs) and protein plugs or casts; RBC casts indicate glomerular injury. Glomerulonephritis may be mild and the hematuria discovered incidentally through a routine urinalysis, or the disease may be severe, with AKI and oliguria.

Some degree of edema and hypertension is present in most patients. Marked proteinuria due to the increased permeability of the glomerular membrane may also occur, with associated pitting edema, hypoalbuminemia, hyperlipidemia, and fatty casts in the urine. Blood urea nitrogen (BUN) and serum creatinine levels may increase as urine output decreases. In addition, anemia may be present.

In the more severe form of the disease, patients also complain of headache, malaise, and flank pain. Older patients may experience circulatory overload with dyspnea, engorged neck veins, cardiomegaly, and pulmonary edema. Atypical symptoms include confusion, somnolence, and seizures, which are often confused with the symptoms of a primary neurologic disorder.

Assessment and Diagnostic Findings

In acute nephritic syndrome, the kidneys become large, edematous, and congested. All renal tissues, including the glomeruli, tubules, and blood vessels, are affected to varying degrees. Patients with an immunoglobulin A (IgA) nephropathy have an elevated serum IgA and low to normal complement levels. Electron microscopy and immunofluorescent analysis help identify the nature of the lesion; however, a kidney biopsy may be needed for definitive diagnosis. See Chapter 43 for discussion of kidney biopsy.

If the patient improves, the amount of urine increases and the urinary protein and sediment diminish. The percentage of adults who recover is unknown. Some patients develop severe

Chart 44-2

Terms Typically Used When Describing Glomerular Disease

Primary: Disease is mainly in glomeruli
Secondary: Glomerular diseases that are the consequence of systemic disease
Idiopathic: Cause is unknown
Acute: Occurs over days or weeks
Chronic: Occurs over months or years
Rapidly progressing: Constant loss of renal function with minimal chance of recovery
Diffuse: Involves all glomeruli
Focal: Involves some glomeruli
Segmental: Involves portions of individual glomeruli
Membranous: Evidence of thickened glomerular capillary walls
Proliferative: Number of glomerular cells involved is increasing

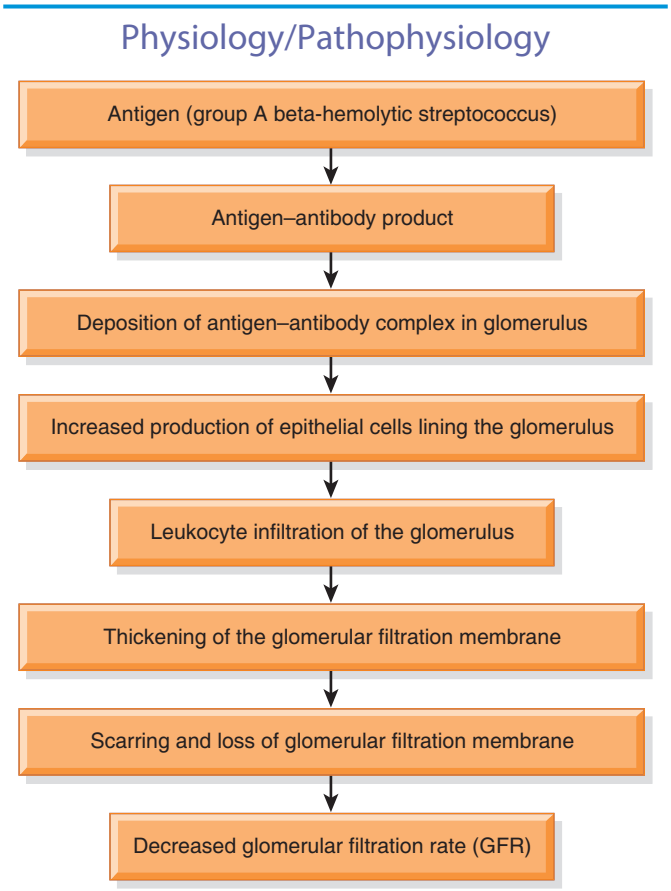


Figure 44-2 • Sequence of events in acute nephritic syndrome.

uremia (an excess of urea and other nitrogenous wastes in the blood) within weeks and require dialysis for survival. Others, after a period of apparent recovery, insidiously develop chronic glomerulonephritis.

Complications

Complications of acute glomerulonephritis include hypertensive encephalopathy, heart failure, and pulmonary edema. Hypertensive encephalopathy is a medical emergency, and therapy is directed toward reducing the blood pressure without impairing renal function. This can occur in acute nephritic syndrome or preeclampsia with chronic hypertension of greater than 140/90 mm Hg. Rapidly progressive glomerulonephritis is characterized by a rapid decline in renal function. Without treatment, ESKD develops in a matter of weeks or months. Signs and symptoms are similar to those of acute glomerulonephritis (hematuria and proteinuria), but the course of the disease is more severe and rapid. Crescent-shaped cells accumulate in Bowman space, disrupting the filtering surface. Plasma exchange (plasmapheresis) and treatment with high-dose corticosteroids and cytotoxic agents have been used to reduce the inflammatory response. Dialysis is initiated in acute glomerulonephritis if signs and symptoms of uremia are severe. The prognosis for patients with acute nephritic syndrome is excellent and rarely causes CKD (Grossman & Porth 2014).

Medical Management

Management consists primarily of treating symptoms, attempting to preserve kidney function, and treating complications promptly. Treatment may include prescribing corticosteroids, managing hypertension, and controlling proteinuria. Pharmacologic therapy depends on the cause of acute glomerulonephritis. If residual streptococcal infection is suspected, penicillin is the agent of choice; however, other antibiotic agents may be prescribed. Dietary protein is restricted when renal insufficiency and nitrogen retention (elevated BUN) develop. Sodium is restricted when the patient has hypertension, edema, and heart failure.

Nursing Management

Although most patients with acute uncomplicated glomerulonephritis are cared for as outpatients, nursing care is important in every setting.

Providing Care in the Hospital

In a hospital setting, carbohydrates are given liberally to provide energy and reduce the catabolism of protein. I&O is carefully measured and recorded. Fluids are given based on the patient's fluid losses and daily body weight. Insensible fluid loss through the lungs (300 mL) and skin (500 mL) is considered when estimating fluid loss (see Chapter 7; Table 7-2). If treatment is effective, diuresis will begin, resulting in decreased edema and blood pressure. Proteinuria and microscopic hematuria may persist for many months; in fact, 20% of patients have some degree of persistent proteinuria or decreased GFR 1 year after presentation (Grossman & Porth, 2014). Other nursing interventions focus on patient education about the disease process, explanations of laboratory and other diagnostic tests, and preparation for safe and effective self-care at home.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

Patient education is directed toward managing symptoms and monitoring for complications. Fluid and diet restrictions must be reviewed with the patient to avoid worsening of edema and hypertension. The patient is instructed verbally and in writing to notify the primary provider if symptoms of kidney disease occur (e.g., fatigue, nausea, vomiting, diminishing urine output) or at the first sign of any infection.

Continuing and Transitional Care

The importance of follow-up evaluations of blood pressure, urinalysis for protein, and BUN and serum creatinine levels to determine if the disease has progressed is stressed to the patient. A referral for transitional, home, or community-based care may be indicated. A home visit from a nurse provides an opportunity for careful assessment of the patient's progress and detection of early signs and symptoms of renal insufficiency. If corticosteroids, immunosuppressant agents, or antibiotic medications are prescribed, the nurse uses the opportunity to review the dosage, desired actions, and adverse effects of medications and the precautions to be taken.

Chronic Glomerulonephritis

Chronic glomerulonephritis may be due to repeated episodes of acute nephritic syndrome, hypertensive nephrosclerosis, hyperlipidemia, chronic tubulointerstitial injury, or hemodynamically mediated glomerular sclerosis. Secondary glomerular diseases that can have systemic effects include systemic lupus erythematosus, Goodpasture syndrome (caused by antibodies to the glomerular basement membrane), diabetic glomerulosclerosis, and amyloidosis.

Pathophysiology

The kidneys are reduced to as little as one fifth their normal size (consisting largely of fibrous tissue). The cortex layer shrinks to 1 to 2 mm in thickness or less. Bands of scar tissue distort the remaining cortex, making the surface of the kidney rough and irregular. Numerous glomeruli and their tubules become scarred, and the branches of the renal artery are thickened. The resulting severe glomerular damage can progress to stage 5 CKD and require a renal replacement therapy.

Clinical Manifestations

The symptoms of chronic glomerulonephritis vary. Some patients with severe disease have no symptoms at all for many years. The condition may be discovered when hypertension or elevated BUN and serum creatinine levels are detected. Most patients report general symptoms, such as loss of weight and strength, increasing irritability, and an increased need to urinate at night (nocturia). Headaches, dizziness, and digestive disturbances are also common.

As chronic glomerulonephritis progresses, signs and symptoms of CKD may develop. The patient appears poorly nourished, with a yellow-gray pigmentation of the skin and periorbital and peripheral (dependent) edema. Blood pressure may be normal or severely elevated. Retinal findings include hemorrhage, exudate, narrowed tortuous arterioles, and papilledema. Anemia causes pale mucous membranes. Cardiomegaly, a gallop rhythm, distended neck veins, and other signs and symptoms of heart failure may be present. Crackles can be heard in the bases of the lungs.

Peripheral neuropathy with diminished deep tendon reflexes and neurosensory changes occur late in the disease. The patient becomes confused and demonstrates a limited attention span. An additional late finding includes evidence of pericarditis with a pericardial friction rub and pulsus paradoxus (difference in

blood pressure during inspiration and expiration of greater than 10 mmHg).

Assessment and Diagnostic Findings

A number of laboratory abnormalities occur. Urinalysis reveals a fixed specific gravity of about 1.010, variable proteinuria, and urinary casts (proteins secreted by damaged kidney tubules). As kidney disease progresses and the GFR falls below 50 mL/min, the following changes occur:

- Hyperkalemia due to decreased potassium excretion, acidosis, catabolism, and excessive potassium intake from food and medications
- Metabolic acidosis from decreased acid secretion by the kidney and inability to regenerate bicarbonate
- Anemia secondary to decreased erythropoiesis (production of RBCs)
- Hypoalbuminemia with edema secondary to protein loss through the damaged glomerular membrane
- Increased serum phosphorus level due to decreased renal excretion of phosphorus
- Decreased serum calcium level (calcium binds to phosphorus to compensate for elevated serum phosphorus levels)
- Mental status changes
- Impaired nerve conduction due to electrolyte abnormalities and uremia

Chest x-rays may show cardiac enlargement and pulmonary edema. The electrocardiogram (ECG) may be normal or may indicate left ventricular hypertrophy associated with hypertension and signs of electrolyte disturbances, such as tall, tented (or peaked) T waves associated with hyperkalemia. Computed tomography (CT) and magnetic resonance imaging (MRI) scans show a decrease in the size of the renal cortex.

Medical Management

Management of symptoms guides the treatment. If the patient has hypertension, efforts are made to reduce the blood pressure with sodium and water restriction, antihypertensive agents, or both. Weight is monitored daily, and diuretic medications are prescribed to treat fluid overload. Proteins of high biologic value (dairy products, eggs, meats) are provided to promote good nutritional status. Adequate calories are provided to spare protein for tissue growth and repair. Urinary tract infections (UTIs) must be treated promptly to prevent further kidney damage.

Dialysis is initiated early in the course of the disease to keep the patient in optimal physical condition, prevent fluid and electrolyte imbalances, and minimize the risk of complications of kidney disease. The course of dialysis is smoother if treatment begins before the patient develops complications.

Nursing Management

Whether the patient is hospitalized or cared for in the home, the nurse observes the patient for common fluid and electrolyte disturbances in kidney disease (see Table 44-1). Changes in fluid and electrolyte status and in cardiac and neurologic status are reported promptly to the primary provider. Throughout the course of the disease and treatment, the nurse gives emotional support by providing opportunities for the patient and family to verbalize their concerns, have their questions answered, and explore their options (Ahmad & Al Nazly, 2015).

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

The nurse has a major role in educating the patient and family about the prescribed treatment plan and the risks associated with noncompliance. Instructions to the patient include explanations and scheduling for follow-up evaluations: blood pressure, urinalysis for protein and casts, and laboratory studies of BUN and serum creatinine levels. If long-term dialysis is needed, the nurse educates the patient and family about the procedure, how to care for the access site, dietary restrictions, and other necessary lifestyle modifications.

Nurse educates about the changes to report to the primary provider such as worsening signs and symptoms of kidney disease, nausea, vomiting, and diminished urine output. Specific education may include explanations about recommended diet and fluid modifications and medications (purpose, desired effects, adverse effects, dosage, and administration schedule).

Continuing and Transitional Care

Periodic laboratory evaluations of creatinine clearance and BUN and serum creatinine levels are carried out to assess residual renal function and the need for dialysis or transplantation. If dialysis is initiated, the patient and family require considerable assistance and support in dealing with therapy and its long-term implications. The patient and family are reminded of the importance of participation in health promotion activities, including health screening. The patient is instructed to inform all health care providers about the diagnosis of glomerulonephritis so that all medical management, including pharmacologic therapy, is based on altered renal function.

Nephrotic Syndrome

Nephrotic syndrome is a type of kidney disease characterized by increased glomerular permeability and is manifested by massive proteinuria (Grossman & Porth, 2014). Clinical findings include a marked increase in protein (particularly albumin) in the urine (proteinuria), a decrease in albumin in the blood (hypoalbuminemia), diffuse edema, high serum cholesterol, and low-density lipoproteins (hyperlipidemia).

The syndrome is apparent in any condition that seriously damages the glomerular capillary membrane and results in increased glomerular permeability to plasma proteins. Although the liver is capable of increasing the production of albumin, it cannot keep up with the daily loss of albumin through the kidneys. Thus, hypoalbuminemia results (see Fig. 44-3).

Pathophysiology

Nephrotic syndrome occurs with many intrinsic kidney diseases and systemic diseases that cause glomerular damage. It is not a specific glomerular disease but a constellation of clinical findings that result from the glomerular damage.

Clinical Manifestations

The major manifestation of nephrotic syndrome is edema. It is usually soft and pitting and commonly occurs around the eyes (periorbital), in dependent areas (sacrum, ankles, and hands), and in the abdomen (ascites). Patients may also exhibit irritability, headache, and malaise.

Assessment and Diagnostic Findings

Proteinuria (predominately albumin) exceeding 3.5 g/day is the hallmark of the diagnosis of nephrotic syndrome. Protein electrophoresis and immunoelectrophoresis may be performed on the urine to categorize the type of proteinuria. The urine may also contain increased white blood cells (WBCs) as well as granular and epithelial casts. A needle biopsy of the kidney

Physiology/Pathophysiology

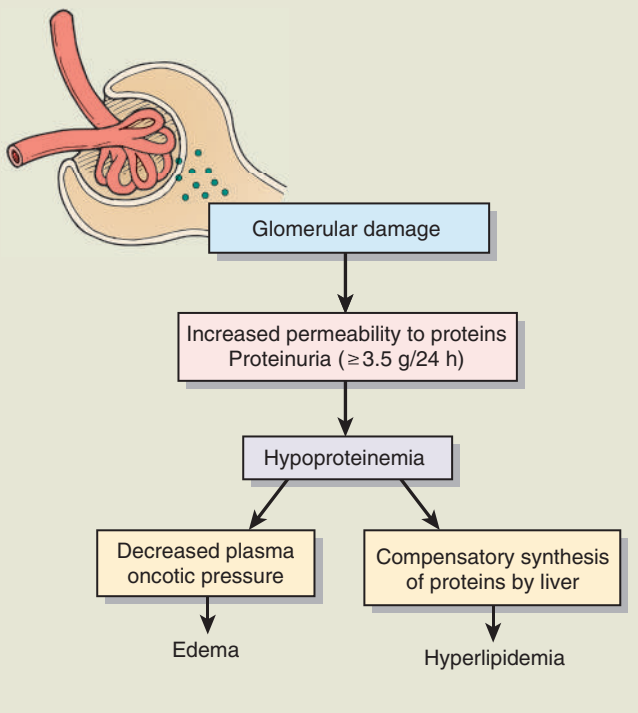


Figure 44-3 • Sequence of events in nephrotic syndrome. Reprinted with permission from Grossman, S. C., & Porth, C. M. (2014). Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

may be performed for histologic examination of renal tissue to confirm the diagnosis.

Complications

Complications of nephrotic syndrome include infection (due to a deficient immune response), thromboembolism (especially of the renal vein), pulmonary embolism, AKI (due to hypovolemia), and accelerated atherosclerosis (due to hyperlipidemia).

Medical Management

Treatment is focused on addressing the underlying disease state causing proteinuria, slowing progression of CKD, and relieving symptoms. Typical treatment includes diuretic agents for edema, ACE inhibitors to reduce proteinuria, and lipid-lowering agents for hyperlipidemia.

Nursing Management

In the early stages of nephrotic syndrome, nursing management is similar to that of the patient with acute glomerulonephritis, but as the condition worsens, management is similar to that of the patient with ESKD.

Patients with nephrotic syndrome need adequate instruction about the importance of following all medication and dietary regimens so that their condition can remain stable as long as possible. Patients must be made aware of the importance of communicating any health-related change to their primary providers as soon as possible so that appropriate medication and dietary changes can be made before further changes occur within the glomeruli.

Polycystic Kidney Disease

Pathophysiology

Polycystic kidney disease (PKD) is a genetic disorder characterized by the growth of numerous fluid-filled cysts in the kidneys, which destroy the nephrons. PKD cysts can profoundly enlarge the kidneys while replacing much of the normal structure, resulting in reduced kidney function and leading to kidney failure.

PKD can also cause cysts in the liver and problems in other areas, such as blood vessels in the brain and heart. The number of cysts and the resulting complications help distinguish PKD from the usually harmless cysts that can form in the kidneys in later years of life. In India, PKD is the attributable cause of kidney failure in 2.5% of the kidney failure patients. The common type of PKD in India is the autosomal dominant one (Jha, 2013). Two major inherited forms of PKD exist:

- Autosomal dominant PKD is the most common inherited form. Symptoms usually develop between 30 and 40 years of age, but they can begin earlier, even in childhood. About 90% of all PKD cases are autosomal dominant PKD.
- Autosomal recessive PKD is a rare inherited form. Symptoms of autosomal recessive PKD begin in the earliest months of life or in utero.

When autosomal dominant PKD causes kidneys to fail, which usually happens after many years, the patient requires dialysis or kidney transplantation. Approximately one half of individuals with autosomal dominant PKD progress to stage 5 CKD, requiring renal replacement therapy.

Clinical Manifestations

Signs and symptoms of PKD result from loss of renal function and the increasing size of the kidneys as the cysts grow. Kidney damage can result in hematuria, polyuria (excessive urine production), hypertension, development of renal calculi and associated UTIs, and proteinuria. The growing cysts are noted with reports of abdominal fullness and flank pain (back and lower sides).

Assessment and Diagnostic Findings

PKD is a genetic disease; therefore, careful evaluation of family history is necessary. Palpation of the abdomen will often reveal enlarged cystic kidneys. Ultrasound imaging of the kidneys is the preferred technique for diagnosis (Grossman & Porth, 2014).

Medical Management

PKD has no cure, and treatment is largely supportive and includes blood pressure control, pain control, and antibiotic agents to resolve infections. Once the kidneys fail, renal replacement therapy is indicated (see later discussion in chapter). Genetic linkage studies and counseling may be indicated, particularly when screening family members for potential kidney donation (Grossman & Porth, 2014).

RENAL CANCER

Renal cancer accounts for about 3% of all cancers in the Indian adult populations and it is considered as one of the cancers which is related with advanced age. In contrast to the male female

Chart 44-3 RISK FACTORS

Renal Cancer

Gender—affects men more than women
Obesity
Occupational exposure to industrial chemicals, such as petroleum products, heavy metals, and asbestos
Polycystic kidney disease
Tobacco use
Unopposed estrogen therapy

Adapted from American Cancer Society (2015). Kidney cancer. Retrieved on 1/10/2015 at: www.cancer.org/cancer/kidneycancer/detailedguide/kidney-cancer-adult-key-statistics

ratio of 2:1 among Americans and rest of the developing world, it is 4:1 in Indian population (Yuvaraja et al., 2016). Tobacco use continues to be a significant risk factor (see Chart 44-3). Those presented with renal cancer at younger age (<39 years) tend to have higher mortality.

The most common type of renal carcinoma arises from the renal epithelium and accounts for more than 85% of all kidney tumors (ACS, 2015). These tumors may metastasize early to the lungs, bone, liver, brain, and contralateral kidney. One quarter of patients have metastatic disease at the time of diagnosis. Although enhanced imaging techniques account for improved detection of early-stage kidney cancer, it is unknown why the rate of late-stage kidney cancers is high.

Clinical Manifestations

Many renal tumors produce no symptoms and are discovered on a routine physical examination as a palpable abdominal mass. Signs and symptoms, which occur in only 10% of patients, include hematuria, pain, and a mass in the flank. The usual sign that first calls attention to the tumor is painless hematuria, which may be either intermittent and microscopic or continuous and gross. There may be a dull pain in the back from the pressure produced by compression of the ureter, extension of the tumor into the perirenal area, or hemorrhage into the kidney tissue. Colicky pains occur if a clot or mass of tumor cells passes down the ureter. Symptoms from metastasis may be the first manifestations of renal tumor and may include unexplained weight loss, increasing weakness, and anemia.

Assessment and Diagnostic Findings

The diagnosis of a renal tumor may require intravenous (IV) urography, cystoscopic examination, renal angiograms, ultrasonography, or a CT scan (see Chapter 43). These tests may be exhausting for patients already debilitated by the systemic effects of a tumor as well as for older patients and those who are anxious about the diagnosis and outcome. The nurse assists the patient to prepare physically and psychologically for these procedures and monitors carefully for signs and symptoms of dehydration and exhaustion.

Medical Management

The goal of medical management is to detect the tumor early and to eradicate slow-growing tumors before metastasis occurs. Treatment most often includes a combination of surgery and pharmacologic management. Radiation therapy may be used for palliation in patients who are not candidates for surgery or other treatments.

Surgical Management

Nephrectomy

A radical nephrectomy is the preferred treatment if the tumor can be removed. This includes removal of the kidney (and tumor), adrenal gland, surrounding perinephric fat and Gerota fascia, and lymph nodes. Laparoscopic nephrectomy can be performed for removal of the kidney with a small tumor. This procedure incurs less morbidity and a shorter recovery time. Radiation therapy, hormonal therapy, or chemotherapy may be used along with surgery. Immunotherapy may also be helpful. For patients with bilateral tumors or cancer of a functional single kidney, nephron-sparing surgery (partial nephrectomy) may be considered. Favorable results have been achieved in patients with small local tumors and a normal contralateral kidney.

Nephron-sparing surgery is increasingly being used to treat patients with solid renal lesions. The technical success rate of nephron-sparing surgery is excellent, and operative morbidity and mortality are low.

Patients with upper tract transitional cell carcinoma may benefit from laparoscopic nephroureterectomy. Although it is a lengthier surgical procedure, it has the same efficacy and is better tolerated by patients than open nephroureterectomy.

Renal Artery Embolization

In patients with metastatic renal carcinoma, the renal artery may be occluded to impede the blood supply to the tumor and thus kill the tumor cells. After angiographic studies are completed, a catheter is advanced into the renal artery, and embolizing materials (e.g., Gelfoam, autologous blood clot, steel coils) are injected into the artery and carried with the arterial blood flow to occlude the tumor vessels mechanically. This decreases the local blood supply, making removal of the kidney (nephrectomy) easier. It also stimulates an immune response because infarction of the renal cell carcinoma releases tumor-associated antigens that enhance the patient's response to metastatic lesions. The procedure may also reduce the number of tumor cells entering the venous circulation during surgical manipulation.

After renal artery embolization and tumor infarction, a characteristic symptom complex called postinfarction syndrome occurs, lasting 2 to 3 days. The patient has pain localized to the flank and abdomen, elevated temperature, and gastrointestinal (GI) symptoms. Pain is treated with parenteral analgesic agents, and acetaminophen/paracetamol (Tylenol) is given to control fever. Antiemetic medications, restriction of oral intake, and IV fluids are used to treat the GI symptoms.

Pharmacologic Therapy

Depending on the stage of the tumor, percutaneous partial or radical nephrectomy may be followed by treatment with chemotherapeutic agents. Treatment with biologic response modifiers such as interleukin 2 (IL-2) is effective. IL-2, a protein that regulates cell growth, is used alone or in combination with lymphokine-activated killer cells (WBCs that have been stimulated by IL-2 to increase their ability to kill cancer cells). Interferon, another biologic response modifier, appears to have a direct antiproliferative effect on renal tumors.

Another promising experimental approach to renal cell carcinoma is a vaccination to stimulate immune response, with autologous tumor cells with IL-2–, granulocyte-macrophage

stimulating factor–, and dendritic cell–type vaccines. If patients with renal cancer do not respond to immunotherapy, allogeneic stem cell transplantation may be indicated (see Chapter 58).

Nursing Management

The patient with a renal tumor usually undergoes extensive diagnostic and therapeutic procedures. Treatment includes surgery, radiation therapy, and medications. After surgery, the patient usually has catheters and drains in place to maintain a patent urinary tract, to remove drainage, and to permit accurate measurement of urine output. Because of the location of the surgical incision, the patient's position during surgery, and the nature of the surgical procedure, pain and muscle soreness are common. Pharmacologic management often includes immunosuppressant agents; therefore, patients are monitored for infection.

The patient requires frequent analgesia during the postoperative period and assistance with turning, coughing, the use of incentive spirometry, and deep breathing to prevent atelectasis and other pulmonary complications. The patient and family require assistance and support to cope with the diagnosis and uncertain prognosis. See discussion later in this chapter of postoperative care of the patient undergoing kidney surgery and Chapter 58 for discussion of care of the patient with cancer.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

The nurse educates the patient about how to inspect and care for the incision and to perform other general postoperative care including activity and lifting restrictions, driving, and pain management. Instructions are provided about when to notify the primary provider about problems (e.g., fever, respiratory difficulty, wound drainage, blood in the urine, pain or swelling of the legs).

The nurse encourages the patient to eat a healthy diet and to drink adequate liquids to avoid constipation and to maintain an adequate urine volume. Education and emotional support are provided related to the diagnosis, treatment, and continuing care because many patients are concerned about the loss of the other kidney, the possible need for dialysis, or the recurrence of cancer.

Continuing and Transitional Care

Follow-up care is essential to detect signs of metastases and to reassure the patient and family about the patient's status and well-being. The patient who has had surgery for renal carcinoma should have a yearly physical examination and chest x-ray, because late metastases are not uncommon. All subsequent symptoms should be evaluated with possible metastases in mind.

If follow-up chemotherapy is necessary, the patient and family are informed about the treatment plan or chemotherapy protocol, what to expect with each visit, and when to notify the primary provider. Evaluation of remaining renal function (creatinine clearance, BUN, and serum creatinine levels) may also be carried out periodically. A home care nurse may monitor the patient's physical status and psychological well-being and coordinate other indicated services and resources.

KIDNEY DISEASE

Kidney disease results when the kidneys cannot remove the body's metabolic wastes or perform their regulatory functions. The substances normally eliminated in the urine accumulate in the body fluids as a result of impaired renal excretion, affecting endocrine and metabolic functions as well as fluid, electrolyte, and acid–base disturbances. Kidney disease is a systemic disease and a final common pathway of many different kidney and urinary tract diseases. Each year, the number of deaths from irreversible kidney disease increases (USRDS, 2015).

Acute Kidney Injury

Acute kidney injury (AKI) is a rapid loss of renal function due to damage to the kidneys. Incidence of acute kidney injury is 31.2% for Southeast Asian countries (Yang Li, 2016).

Common contributing causes of acute renal injury in India are diarrheal illness, malaria, snake bite. Contrarily, in Western countries, the main causative factors of acute renal injury are hemolytic uremic syndrome, major complicated surgeries, etc. (Inbanathan & Lavanya, 2016).

Depending on the duration and severity of AKI, a wide range of potentially life-threatening metabolic complications can occur, including metabolic acidosis as well as fluid and electrolyte imbalances (Vritis, 2013). Treatment is aimed at replacing renal function temporarily to minimize potentially lethal complications and reduce potential causes of increased kidney injury with the goal of minimizing long-term loss of renal function. AKI is a problem seen in patients who are hospitalized and those in outpatient settings. A widely accepted criterion for AKI is a 50% or greater increase in serum creatinine above baseline (normal creatinine is less than 1 mg/dL) (Vritis, 2013). Urine volume may be normal, or changes may occur. Possible changes include nonoliguria (greater than 800 mL/day), oliguria (less than 0.5 mL/kg/hr), or anuria (less than 50 mL/day) (Vritis, 2013).

Pathophysiology

In the pathogenesis of AKI and oliguria, many times there is a specific underlying cause. Pathophysiology of acute kidney injury is presented in Figure 44-4. Some of the factors may be reversible if identified and treated promptly, before kidney function is impaired. This is true of the following conditions that reduce blood flow to the kidney and impair kidney function: (1) hypovolemia; (2) hypotension; (3) reduced cardiac output and heart failure; (4) obstruction of the kidney or lower urinary tract by tumor, blood clot, or kidney stone; and (5) bilateral obstruction of the renal arteries or veins. If these conditions are treated and corrected before the kidneys are permanently damaged, the increased BUN and creatinine levels, oliguria, and other signs may be reversed.

Although renal stones are not a common cause of AKI, some types may increase the risk of AKI. Some hereditary stone diseases (see Chapter 45), primary struvite stones, and infection-related urolithiasis associated with anatomic and functional urinary tract anomalies and spinal cord injury may cause recurrent bouts of obstruction as well as crystal-specific damage to tubular epithelial cells and interstitial renal cells.

Classifications

The term acute kidney injury has replaced the term acute renal failure because it better describes this syndrome in patients, not only simply those who require renal replacement therapies but also those patients who experience minor changes in renal function. Classification criteria for AKI include assessment of

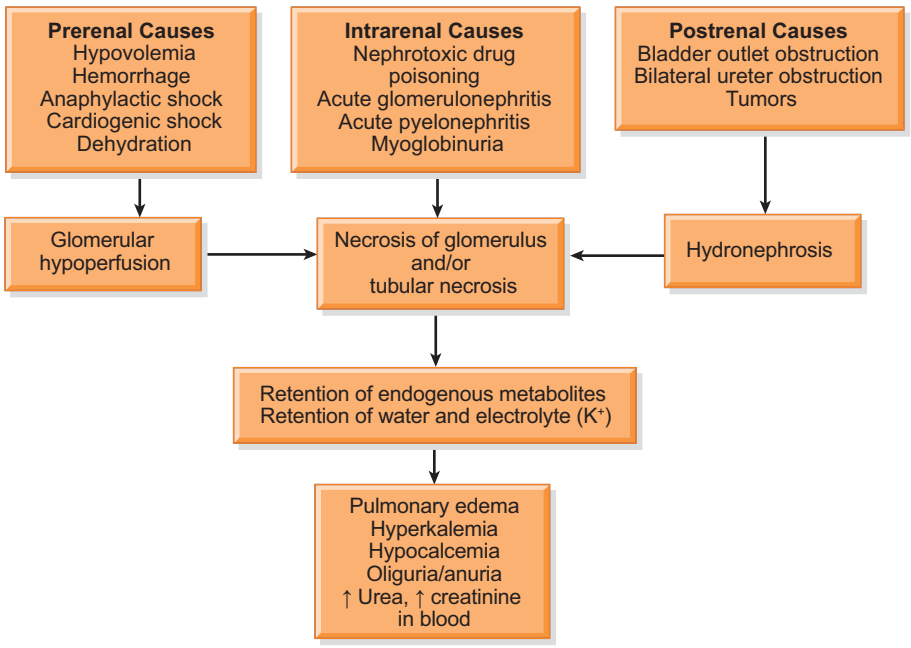


Figure 44-4 • Pathophysiology of acute kidney injury.

three grades of severity and two outcome-level classifications. This 5-point system is known as the RIFLE classification system (Davies & Leslie, 2012). RIFLE stands for risk, injury, failure, loss, and ESKD (Vrtis, 2013). Risk, injury, and failure are considered grades of AKI severity, whereas loss and ESKD are considered outcomes of loss that require some form of renal replacement therapy, at least temporarily (Dring & Hipkiss, 2015). Table 44-2 lists the classification criteria for the RIFLE system for AKI (Vritis, 2013). This classification system is used by health care professionals to identify kidney injury and improve patient outcomes.

TABLE 44-2 The RIFLE Classification for Acute Kidney Injury

Class	GFR Criteria	Urinary Output Criteria
R (Risk)	Increased serum creatinine 1.5 × baseline OR GFR decreased ≥25%	0.5 mL/kg/hr for 6 hours
I (Injury)	Increased serum creatinine 2 × baseline OR GFR decreased ≥50%	0.5 mL/kg/hr for 12 hours
F (Failure)	Increased serum creatinine 3 × baseline OR GFR decreased ≥75% OR Serum creatinine ≥354 mmol/L with an acute rise of at least 44 mmol/L	<0.3 mL/kg/hr for 24 hours OR Anuria for 12 hours
L (Loss)	Persistent acute kidney injury = complete loss of kidney function >4 weeks	
E (ESKD)	ESKD >3 months	

ESKD, end-stage kidney disease; GFR, glomerular filtration rate.
Adapted from Davies, H., & Leslie, G. (2012). Acute kidney injury and the critically ill patient. Dimensions of Critical Care Nursing, 31(3), 135–152.

Categories

The major categories of AKI are prerenal (hypoperfusion of kidney), intrarenal (actual damage to kidney tissue), and postrenal (obstruction to urine flow). Prerenal AKI, which occurs in 60% to 70% of cases, is the result of impaired blood flow that leads to hypoperfusion of the kidney commonly caused by volume depletion (burns, hemorrhage, GI losses), hypotension (sepsis, shock), and renal artery stenosis, ultimately leading to a decrease in the GFR (Vritis, 2013). Intrarenal AKI is the result of actual parenchymal damage to the glomeruli or kidney tubules. Acute tubular necrosis (ATN), or AKI in which there is damage to the kidney tubules, is the most common type of intrinsic AKI. Characteristics of ATN are intratubular obstruction, tubular back leak (abnormal reabsorption of filtrate and decreased urine flow through the tubule), vasoconstriction, and changes in glomerular permeability. These processes result in a decrease of GFR, progressive azotemia, and fluid and electrolyte imbalances. CKD, diabetes, heart failure, hypertension, and cirrhosis can lead to ATN. Postrenal AKI usually results from obstruction distal to the kidney by conditions such as renal calculi, strictures, blood clots, benign prostatic hypertrophy, malignancies, and pregnancy. Pressure rises in the kidney tubules, and eventually the GFR decreases. Common causes of each type of AKI are further summarized in Chart 44-4.

Phases

There are four phases of AKI: initiation, oliguria, diuresis, and recovery.

- The initiation period begins with the initial insult and ends when oliguria develops.
- The oliguria period is accompanied by an increase in the serum concentration of substances usually excreted by the kidneys (urea, creatinine, uric acid, organic acids, and the intracellular cations [potassium and magnesium]). The minimum amount of urine needed to rid the body of normal metabolic waste products is 400 mL in 24 hours or 0.5 mL/kg/hr. In this phase, uremic symptoms first appear and life-threatening conditions such as hyperkalemia develop.

Chart 44-4

Causes of Acute Kidney Injury

Prerenal Failure

- Volume depletion resulting from:
  - Gastrointestinal losses (vomiting, diarrhea, nasogastric suction)
  - Hemorrhage
  - Renal losses (diuretic agents, osmotic diuresis)
- Impaired cardiac efficiency resulting from:
  - Cardiogenic shock
  - Dysrhythmias
  - Heart failure
  - Myocardial infarction
- Vasodilation resulting from:
  - Anaphylaxis
  - Antihypertensive medications or other medications that cause vasodilation
  - Sepsis

Intrarenal Failure

- Prolonged renal ischemia resulting from:
  - Hemoglobinuria (transfusion reaction, hemolytic anemia)
  - Rhabdomyolysis/myoglobinuria (trauma, crush injuries, burns)
  - Pigment nephropathy (associated with the breakdown of blood cells containing pigments that in turn occlude kidney structures)
- Nephrotoxic agents such as:
  - Aminoglycoside antibiotics (gentamicin, tobramycin)
  - Angiotensin-converting enzyme inhibitors
  - Heavy metals (lead, mercury)
  - Nonsteroidal anti-inflammatory drugs
  - Radiopaque contrast agents
  - Solvents and chemicals (ethylene glycol, carbon tetrachloride, arsenic)
- Infectious processes such as:
  - Acute glomerulonephritis
  - Acute pyelonephritis

Postrenal Failure

- Urinary tract obstruction, including:
  - Benign prostatic hyperplasia
  - Blood clots
  - Calculi (stones)
  - Strictures
  - Tumors

- The diuresis period is marked by a gradual increase in urine output, which signals that glomerular filtration has started to recover. Laboratory values stabilize and eventually decrease. Although the volume of urinary output may reach normal or elevated levels, renal function may still be markedly abnormal. Because uremic symptoms may still be present, the need for expert medical and nursing management continues. The patient must be observed closely for dehydration during this phase; if dehydration occurs, the uremic symptoms are likely to increase.
- The recovery period signals the improvement of renal function and may take 3 to 12 months. Laboratory values return to the patient's normal level. Although a permanent 1% to 3% reduction in the GFR may occur, it is not clinically significant.

Some patients have decreased renal function with increasing nitrogen retention but actually excrete normal amounts of urine (1 to 2 L/day). This is the nonoliguric form of kidney injury and occurs predominantly after exposure of the patient to nephrotoxic agents (any substance, medication, or action that destroys kidney tissue), burns, traumatic injury, and the use of halogenated anesthetic agents.

Clinical Manifestations

Almost every system of the body is affected with failure of the normal renal regulatory mechanisms. The patient may appear critically ill and lethargic. The skin and mucous membranes are dry from dehydration. Central nervous system signs and symptoms include drowsiness, headache, muscle twitching, and seizures. Table 44-3 summarizes common clinical characteristics in all three categories of AKI.

Assessment and Diagnostic Findings

Assessment of the patient with AKI includes evaluation for changes in the urine, diagnostic tests that evaluate the kidney contour, and a variety of laboratory values. See Chapter 43 for information about the normal characteristics of urine, diagnostic findings, and laboratory values in the renal system.

In AKI, urine output varies from scanty to a normal volume, hematuria may be present, and the urine has a low specific gravity (compared with a normal value of 1.010 to 1.025). One of the earliest manifestations of tubular damage is the inability to concentrate the urine (Vritis, 2013). Patients with prerenal azotemia have a decreased amount of sodium in the urine (less than 20 mEq/L) and normal urinary sediment. Patients with

TABLE 44-3 Comparing Clinical Characteristics of Acute Kidney Injury

	Categories		
Characteristics	Prerenal	Intrarenal	Postrenal
Etiology	Hypoperfusion	Parenchymal damage	Obstruction
Blood urea nitrogen value	↑ (out of normal 20:1 proportion to creatinine)	↑	↑
Creatinine	↑	↑	↑
Urine output	↓	Varies, often ↓	Varies, may be ↓, or sudden anuria
Urine sodium	↓ to <20 mEq/L	↑ to >40 mEq/L	Varies, often ↓ to ≤20 mEq/L
Urinary sediment	Normal, few hyaline casts	Abnormal casts and debris	Usually normal
Urine osmolality	↑ to 500 mOsm	~350 mOsm, similar to serum	Varies, ↑ or equal to serum
Urine specific gravity	↑	Low normal	Varies

↑, increased; ↓, decreased.

intrarenal azotemia usually have urinary sodium levels greater than 40 mEq/L with **urinary casts** and other cellular debris.

Ultrasonography is a critical component of the evaluation of patients with kidney disease. A renal sonogram or a CT or MRI scan may show evidence of anatomic changes.

The BUN level increases steadily at a rate that depends on the degree of catabolism (breakdown of protein), renal perfusion, and protein intake. Serum creatinine levels are useful in monitoring kidney function and disease progression and increase with glomerular damage.

With a decline in the GFR, oliguria, and anuria, patients are at high risk for hyperkalemia. Protein catabolism results in the release of cellular potassium into the body fluids, causing severe hyperkalemia (high serum potassium levels). Hyperkalemia may lead to dysrhythmias, such as ventricular tachycardia and cardiac arrest. Sources of potassium include normal tissue catabolism, dietary intake, blood in the GI tract, or blood transfusion and other sources (e.g., IV infusions, potassium penicillin, and extracellular shift in response to metabolic acidosis).

Progressive metabolic acidosis occurs in kidney disease because patients cannot eliminate the daily metabolic load of acid-type substances produced by the normal metabolic processes. In addition, normal renal buffering mechanisms fail. This is reflected by decreased serum carbon dioxide (CO_2) and pH levels.

Blood phosphate concentrations may increase; calcium levels may be low due to decreased absorption of calcium from the intestine and as a compensatory mechanism for the elevated blood phosphate levels. Anemia is another common laboratory finding in AKI, as a result of reduced erythropoietin production, uremic GI lesions, reduced RBC lifespan, and blood loss from the GI tract.

Prevention

AKI has a high mortality rate that ranges from 40% to 90%. Factors that influence mortality include increased age, comorbid conditions, and pre-existing kidney and vascular diseases and respiratory failure (Vritis, 2013). Therefore, prevention of AKI is essential (see Chart 44-5).

A careful history is obtained to identify exposure to nephrotoxic agents or environmental toxins. The kidneys are susceptible to the adverse effects of medications because the metabolic by-products of most medications are excreted by the kidneys. Patients taking nephrotoxic medications (e.g., aminoglycosides, gentamicin [Garamycin], tobramycin, colistimethate [Coly-Mycin], polymyxin B, amphotericin B, vancomycin, amikacin [Amikin], cyclosporine [Neoral]) should be monitored closely for changes in renal function. Kidney function needs to be monitored prior to initiation of these medications and during therapy (Prentice, 2013).

Any agent that reduces renal blood flow (e.g., long-term analgesic use) may cause renal insufficiency. Chronic use of analgesic agents, particularly nonsteroidal anti-inflammatory drugs (NSAIDs), may cause interstitial nephritis (inflammation within the renal tissue) and papillary necrosis. Patients with heart failure or cirrhosis with ascites are at particular risk for NSAID-induced kidney disease. Increased age, pre-existing kidney disease, and the simultaneous administration of several nephrotoxic agents increase the risk of kidney damage.

Radiocontrast-induced nephropathy (CIN) is the third major cause of hospital-acquired AKI. Other most common causes of hospital-acquired AKI are hypovolemia and sepsis (Goswami, Vohra, Raju, et al., 2016). CIN is a potentially preventable condition. Baseline levels of creatinine greater than 2 mg/dL identify patients at high risk. Limiting the patient's exposure to contrast agents and nephrotoxic medications will reduce the risk of CIN (Rank, 2013). Administration of N-acetylcysteine and sodium bicarbonate before and during procedures reduces risk, but prehydration with saline is considered the most effective method to prevent CIN (Rank, 2013).

Chart 44-5

Preventing Acute Kidney Injury

- Continually assess renal function (urine output, laboratory values) when appropriate.
- Monitor central venous and arterial pressures and hourly urine output of critically ill patients to detect the onset of kidney disease as early as possible.
- Pay special attention to wounds, burns, and other precursors of sepsis.
- Prevent and treat infections promptly. Infections can produce progressive kidney damage.
- Prevent and treat shock promptly with blood and fluid replacement.
- Provide adequate hydration to patients at risk for dehydration, including:
  - Before, during, and after surgery
  - Patients undergoing intensive diagnostic studies requiring fluid restriction and contrast agents (e.g., barium enema, IV pyelograms), especially older patients who may have marginal renal reserve
  - Patients with neoplastic disorders or disorders of metabolism (e.g., gout) and those receiving chemotherapy
  - Patients with skeletal muscle injuries (e.g., crush injuries, compartment syndrome)
  - Patients with heat-induced illnesses (e.g., heat stroke, heat exhaustion)
- Take precautions to ensure that the appropriate blood is given to the correct patient in order to avoid severe transfusion reactions, which can precipitate kidney disease.
- To prevent infections from ascending in the urinary tract, give meticulous care to patients with indwelling catheters. Remove catheters as soon as possible.
- To prevent toxic drug effects, closely monitor dosage, duration of use, and blood levels of all medications metabolized or excreted by the kidneys.
- Treat hypotension promptly.

Gerontologic Considerations

About half of all patients who develop AKI during hospitalization are older than 60 years. The etiology of AKI in older adults includes prerenal causes such as dehydration, intrarenal causes such as nephrotoxic agents (e.g., medications, contrast agents), and complications of major surgery (Elliott, 2012). Suppression of thirst, enforced bed rest, lack of access to drinking water, and confusion all contribute to the older patient's failure to consume adequate fluids and may lead to dehydration, further compromising already decreased renal function.

AKI in older adults is also often seen in the community setting. Nurses in the ambulatory setting need to be aware of the risk. All medications need to be monitored for potential side effects that could result in damage to the kidney either through reduced circulation or nephrotoxicity. Outpatient procedures that require fasting or a bowel preparation may cause dehydration and therefore require careful monitoring.

Medical Management

The kidneys have a remarkable ability to recover from insult. The objectives of treatment for AKI are to restore normal chemical balance and prevent complications until repair of renal tissue and restoration of renal function can occur. Management includes eliminating the underlying cause; maintaining fluid balance; avoiding fluid excesses; and, when indicated, providing renal replacement therapy. Prerenal azotemia is treated by optimizing renal perfusion, whereas postrenal failure is treated by relieving the obstruction. Intrarenal azotemia is treated with supportive therapy, with removal of causative agents, aggressive management of prerenal and postrenal failure, and avoidance of associated risk factors. Shock and infection, if present, are treated promptly (see Chapter 8). The presence of myoglobin in the urine (i.e., myoglobinuria) in the patient who has had a crush injury, compartment syndrome, or heat-induced illness is treated for rhabdomyolysis (see Chapter 60).

Maintenance of fluid balance is based on daily body weight, serial measurements of central venous pressure, serum and urine concentrations, fluid losses, blood pressure, and the clinical status of the patient. The parenteral and oral intake and the output of urine, gastric drainage, stools, wound drainage, and perspiration are calculated and are used as the basis for fluid replacement. The insensible fluid produced through the normal metabolic processes and lost through the skin and lungs is also considered in fluid management.

Fluid excesses can be detected by the clinical findings of dyspnea, tachycardia, and distended neck veins. The patient's lungs are auscultated for moist crackles. Because pulmonary edema may be caused by excessive administration of parenteral fluids, extreme caution must be used to prevent fluid overload. The development of generalized edema is assessed by examining the presacral and pretibial areas several times daily. Mannitol (Osmitrol), furosemide (Lasix), or ethacrynic acid (Edecrin) may be prescribed to initiate diuresis (Walton, 2015).

Adequate renal blood flow in patients with prerenal causes of AKI may be restored by IV fluids or transfusions of blood products. If AKI is caused by hypovolemia secondary to hypoproteinemia, an infusion of albumin may be prescribed. Dialysis may be initiated to prevent complications of AKI, such as hyperkalemia, metabolic acidosis, pericarditis, and pulmonary edema. Dialysis corrects many biochemical abnormalities; allows for liberalization of fluid, protein, and sodium intake; diminishes bleeding tendencies; and promotes wound healing. Hemodialysis (a procedure that circulates the patient's blood through an artificial kidney [dialyzer] to remove waste products and excess fluid), peritoneal dialysis (PD; a procedure that uses the patient's peritoneal membrane [the lining of the peritoneal cavity] as the semipermeable membrane to exchange fluid and solutes), or a variety of continuous renal replacement therapies (CRRTs) (methods used to replace normal kidney function by circulating the patient's blood through a hemofilter) may be performed (Dirkes, 2014). These and other treatment modalities for patients with renal dysfunction are discussed later in this chapter.

Pharmacologic Therapy

Hyperkalemia is the most life threatening of the fluid and electrolyte changes that occur in patients with kidney disorders. Therefore, the patient is monitored for hyperkalemia through serial serum electrolyte levels (potassium value greater than 5.0 mEq/L [5 mmol/L]), ECG changes (tall, tented, or peaked T waves), and changes in clinical status (see Chapter 7). Other symptoms of hyperkalemia include irritability, abdominal cramping, diarrhea, paresthesia, and generalized muscle weakness. Muscle weakness may present as slurred speech, difficulty breathing, paresthesia, and paralysis. As the potassium level increases, both cardiac and other muscular function declines, making this a medical emergency.

The elevated potassium levels may be reduced by administering cation-exchange resins (sodium polystyrene sulfonate [Kayexalate]) orally or by retention enema. Kayexalate works by exchanging sodium ions for potassium ions in the intestinal tract. Sorbitol may be given in combination with Kayexalate to induce a diarrhea-type effect (it induces water loss in the GI tract). If a Kayexalate retention enema is given (the colon is the major site of potassium exchange), a rectal catheter with a balloon may be used to facilitate retention if necessary. The patient should retain the Kayexalate for at least 30 to 60 minutes (preferable 6 to 10 hours) to promote potassium removal (Comerford, 2015). Afterward, a cleansing enema may be prescribed to remove remaining medication as a precaution against fecal impaction.

If the patient is hemodynamically unstable (low blood pressure, changes in mental status, dysrhythmia), IV dextrose 50%, insulin, and calcium replacement may be given to shift potassium back into the cells. The shift of potassium into the intracellular space is temporary, so arrangements for dialysis need to be made on an emergent basis.

Many medications are eliminated through the kidneys; therefore, dosages must be reduced when a patient has AKI. Examples of commonly used agents that require adjustment are antibiotic medications (especially aminoglycosides), digoxin (Lanoxin), phenytoin (Dilantin), ACE inhibitors, and magnesium-containing agents.

In addition, many medications have been used in patients with AKI in an attempt to improve patient outcomes. Diuretic agents are often used to control fluid volume, but they have not been shown to improve recovery from AKI (Prentice, 2013).

In patients with severe acidosis, the arterial blood gases and serum bicarbonate levels (CO_2) must be monitored because the patient may require sodium bicarbonate therapy or dialysis. If respiratory problems develop, appropriate ventilatory measures must be instituted. The elevated serum phosphate level may be controlled with phosphate-binding agents (e.g., calcium or lanthanum carbonate) that help prevent a continuing rise in serum phosphate levels by decreasing the absorption of phosphate from the intestinal tract.

Nutritional Therapy

AKI causes severe nutritional imbalances (because nausea and vomiting contribute to inadequate dietary intake), impaired glucose use and protein synthesis, and increased tissue catabolism. The patient is weighed daily at the same time using the same scale and loses 0.2 to 0.5 kg daily if the nitrogen balance is negative (i.e., caloric intake falls below caloric requirements). If the patient gains or does not lose weight or develops hypertension, fluid retention should be suspected.

Nutritional support is based on the underlying cause of AKI, the catabolic response, the type and frequency of renal replacement therapy, comorbidities, and nutritional status. Replacement of dietary proteins is individualized to provide the maximum benefit and minimize uremic symptoms. Caloric requirements are met with high-carbohydrate meals, because carbohydrates have a protein-sparing effect (i.e., in a high-carbohydrate diet, protein is not used for meeting energy

requirements but is "spared" for growth and tissue healing). Foods and fluids containing potassium or phosphorus (e.g., bananas, citrus fruits and juices, coffee) are restricted.

The oliguric phase of AKI may last 10 to 14 days and is followed by the diuretic phase, at which time urine output begins to increase, signaling the patient is in the recovery phase (Prentice, 2013). Results of blood chemistry tests are used to determine the amounts of sodium, potassium, and water needed for replacement, along with assessment for over- or underhydration. Following the diuretic phase, the patient is placed on a high-protein, high-calorie diet and is encouraged to resume activities gradually.

Nursing Management

The nurse has an important role in caring for the patient with AKI. The nurse monitors for complications, participates in emergency treatment of fluid and electrolyte imbalances, assesses the patient's progress and response to treatment, and provides physical and emotional support. In addition, the nurse keeps family members informed about the patient's condition, helps them understand the treatments, and provides psychological support. Although the development of AKI may be the most serious problem, the nurse continues to provide nursing care indicated for the primary disorder (e.g., burns, shock, trauma, obstruction of the urinary tract).

Monitoring Fluid and Electrolyte Balance

Because of the serious fluid and electrolyte imbalances that can occur with AKI, the nurse monitors the patient's serum electrolyte levels and physical indicators of these complications during all phases of the disorder. IV solutions must be carefully selected based on the patient's fluid and electrolyte status. The patient's cardiac function and musculoskeletal status are monitored closely for signs of hyperkalemia.

Nursing Alert: Hyperkalemia is the most immediate life-threatening imbalance seen in AKI. Parenteral fluids, all oral intake, and all medications are screened carefully to ensure that sources of potassium are not inadvertently given or consumed.

The nurse monitors fluid status by paying careful attention to fluid intake (IV medications should be given in the smallest volume possible), urine output, apparent edema, distention of the jugular veins, alterations in heart sounds and breath sounds, and increasing difficulty in breathing. Accurate daily weights, as well as I&O records, are essential. Indicators of deteriorating fluid and electrolyte status are reported immediately to the primary provider, and preparation is made for emergency treatment. Severe fluid and electrolyte disturbances may be treated with hemodialysis, PD, or CRRT.

Reducing Metabolic Rate

The nurse takes steps to reduce the patient's metabolic rate. Bed rest may be indicated to reduce exertion and the metabolic rate during the most acute stage of the disorder. Fever and infection, both of which increase the metabolic rate and catabolism, are prevented or treated promptly.

Promoting Pulmonary Function

Attention is given to pulmonary function, and the patient is assisted to turn, cough, and take deep breaths frequently to prevent atelectasis and respiratory tract infection. Drowsiness and lethargy may prevent the patient from moving and turning without encouragement and assistance.

Preventing Infection

Asepsis is essential with invasive lines and catheters to minimize the risk of infection and increased metabolism. An indwelling urinary catheter is avoided whenever possible due to the high risk of UTI associated with its use but may be required to provide ongoing data required to accurately monitor fluid I&O.

Providing Skin Care

The skin may be dry or susceptible to breakdown as a result of edema; therefore, meticulous skin care is important. In addition, excoriation and itching of the skin may result from the deposit of irritating toxins in the patient's tissues. Bathing the patient with cool water, frequent turning, and keeping the skin clean and well moisturized and the fingernails trimmed to avoid excoriation are often comforting and prevent skin breakdown.

Providing Psychosocial Support

The patient with AKI may require treatment with hemodialysis, PD, or CRRT. The length of time that these treatments are necessary varies with the cause and extent of damage to the kidneys. The patient and family need assistance, explanation, and support during this period. The purpose of the treatment is explained to the patient and family by the primary provider. However, high levels of anxiety and fear may necessitate repeated explanation and clarification by the nurse. The family members may initially be afraid to touch and talk to the patient during these procedures but should be encouraged and assisted to do so.

In an intensive care setting, many of the nurse's functions are devoted to the technical aspects of patient care; however, it is essential that the psychological needs and other concerns of the patient and family be addressed. Continued assessment of the patient for complications of AKI and precipitating causes is essential (Davies & Leslie, 2012).

End-Stage Kidney Disease or Chronic Kidney Disease

When a patient has sustained enough kidney damage to require renal replacement therapy on a permanent basis, the patient has moved into the fifth or final stage of CKD, also referred to as ESKD.

Pathophysiology

As renal function declines, the end products of protein metabolism (normally excreted in urine) accumulate in the blood. Uremia develops and adversely affects every system in the body. The greater the buildup of waste products, the more pronounced the symptoms.

The rate of decline in renal function and progression of ESKD is related to the underlying disorder, the urinary excretion of protein, and the presence of hypertension. The disease tends to progress more rapidly in patients who excrete significant amounts of protein or have elevated blood pressure than in those without these conditions.

Clinical Manifestations

Because virtually every body system is affected in ESKD, patients exhibit a number of signs and symptoms. The severity of these signs and symptoms depends in part on the degree of

renal impairment, other underlying conditions, and the patient's age. Cardiovascular disease is the predominant cause of death in patients with ESKD (Walton, 2015). Peripheral neuropathy, a disorder of the peripheral nervous system, is present in some patients. Patients complain of severe pain and discomfort. Restless leg syndrome and burning feet can occur in the early stage of uremic peripheral neuropathy. The precise mechanisms for many of these systemic signs and symptoms have not been identified. However, it is generally thought that the accumulation of uremic waste products is the probable cause. Chart 44-6 summarizes the systemic signs and symptoms.

Assessment and Diagnostic Findings

Glomerular Filtration Rate

As the GFR decreases (due to nonfunctioning glomeruli), the creatinine clearance decreases, whereas the serum creatinine and BUN levels increase. Serum creatinine is a more sensitive indicator of renal function than BUN. The BUN is affected not only by kidney disease but also by protein intake in the diet, catabolism (tissue and RBC breakdown), parenteral nutrition, and medications such as corticosteroids.

Sodium and Water Retention

The kidney cannot concentrate or dilute the urine normally in ESKD. Appropriate responses by the kidney to changes in the daily intake of water and electrolytes, therefore, do not occur. Some patients retain sodium and water, increasing the risk for edema, heart failure, and hypertension. Hypertension may also result from activation of the renin–angiotensin–aldosterone axis and the concomitant increased aldosterone secretion. Other patients have a tendency to lose sodium and run the risk of developing hypotension and hypovolemia. Vomiting and diarrhea may cause sodium and water depletion, which worsens the uremic state.

Acidosis

Metabolic acidosis occurs in ESKD because the kidneys are unable to excrete increased loads of acid. Decreased acid secretion results from the inability of the kidney tubules to excrete ammonia (NH_3^-) and to reabsorb sodium bicarbonate (HCO_3^-). There is also decreased excretion of phosphates and other organic acids.

Anemia

Anemia develops as a result of inadequate erythropoietin production, the shortened lifespan of RBCs, nutritional

Chart 44-6 ASSESSMENT

Assessing for End-Stage Kidney Disease

Be alert to the following signs and symptoms:

Neurologic

- Asterixis
- Behavior changes
- Burning of soles of feet
- Confusion
- Disorientation
- Inability to concentrate
- Restlessness of legs
- Seizures
- Tremors
- Weakness and fatigue

Integumentary

- Coarse, thinning hair
- Dry, flaky skin
- Ecchymosis
- Gray-bronze skin color
- Pruritus
- Purpura
- Thin, brittle nails

Cardiovascular

- Engorged neck veins
- Hyperkalemia
- Hyperlipidemia
- Hypertension
- Pericardial effusion
- Pericardial friction rub
- Pericardial tamponade
- Pericarditis
- Periorbital edema
- Pitting edema (feet, hands, sacrum)

Pulmonary

- Crackles
- Depressed cough reflex
- Kussmaul-type respirations
- Pleuritic pain
- Shortness of breath
- Tachypnea
- Thick, tenacious sputum
- Uremic pneumonitis

Gastrointestinal

- Ammonia odor to breath ("uremic fetor")
- Anorexia, nausea, and vomiting
- Bleeding from gastrointestinal tract
- Constipation or diarrhea
- Hiccups
- Metallic taste
- Mouth ulcerations and bleeding

Hematologic

- Anemia
- Thrombocytopenia

Reproductive

- Amenorrhea
- Decreased libido
- Infertility
- Testicular atrophy

Musculoskeletal

- Bone fractures
- Bone pain
- Footdrop
- Loss of muscle strength
- Muscle cramps
- Renal osteodystrophy

deficiencies, and the patient's tendency to bleed, particularly from the GI tract. Erythropoietin, a substance normally produced by the kidneys, stimulates bone marrow to produce RBCs. In ESKD, erythropoietin production decreases and profound anemia results, producing fatigue, angina, and shortness of breath.

Calcium and Phosphorus Imbalance

Another abnormality seen in ESKD is a disorder in calcium and phosphorus metabolism. Serum calcium and phosphate levels have a reciprocal relationship in the body: As one increases, the other decreases. With a decrease in filtration through the glomerulus of the kidney, there is an increase in the serum phosphate level and a reciprocal or corresponding decrease in the serum calcium level. The decreased serum calcium level causes increased secretion of parathormone from the parathyroid glands. However, in kidney disease, the body does not respond normally to the increased secretion of parathormone; as a result, calcium leaves the bone, often producing bone changes and bone disease as well as calcification of major blood vessels in the body. In addition, the active metabolite of vitamin D (1,25-dihydroxycholecalciferol) normally manufactured by the kidney decreases as kidney disease progresses (Counts, 2015). Uremic bone disease, often called renal osteodystrophy, develops from the complex changes in calcium, phosphate, and parathormone balance. There is also evidence of calcification of blood vessels.

Complications

There are a number of potential complications of ESKD that necessitate a collaborative approach to care. These include the following:

- Anemia due to decreased erythropoietin production, decreased RBC lifespan, bleeding in the GI tract from irritating toxins and ulcer formation, and blood loss during hemodialysis
- Bone disease and metastatic and vascular calcifications due to retention of phosphorus, low serum calcium levels, abnormal vitamin D metabolism, and elevated aluminum levels
- Hyperkalemia due to decreased excretion, metabolic acidosis, catabolism, and excessive intake (diet, medications, fluids)
- Hypertension due to sodium and water retention and malfunction of the renin–angiotensin–aldosterone system
- Pericarditis, pericardial effusion, and pericardial tamponade due to retention of uremic waste products and inadequate dialysis

Medical Management

The goal of management is to maintain kidney function and homeostasis for as long as possible. All factors that contribute to ESKD and all factors that are reversible (e.g., obstruction) are identified and treated. Management is accomplished primarily with medications and diet therapy, although dialysis may also be needed to decrease the level of uremic waste products in the blood and to control electrolyte balance.

Pharmacologic Therapy

Complications can be prevented or delayed by administering prescribed phosphate-binding agents, calcium supplements, antihypertensive and cardiac medications, anticonvulsant medications, and recombinant human erythropoietin (epoetin alfa [Epogen]).

Calcium and Phosphorus Binders

Hyperphosphatemia and hypocalcemia are treated with medications that bind dietary phosphorus in the GI tract. Binders such as calcium carbonate (Os-Cal) or calcium acetate (PhosLo) are prescribed, but there is a risk of hypercalcemia. If calcium is high or the calcium–phosphorus product exceeds 55 mg/dL, a polymeric phosphate binder such as sevelamer hydrochloride (Renagel) may be prescribed (Walton, 2015). This medication binds dietary phosphorus in the intestinal tract; one to four tablets are given with food to be effective. Magnesium-based antacid agents are avoided to prevent magnesium toxicity.

Antihypertensive and Cardiovascular Agents

Hypertension is managed by intravascular volume control and a variety of antihypertensive agents (Weiner, Brunelli, Hunt, et al., 2014). Heart failure and pulmonary edema may also require treatment with fluid restriction, low-sodium diets, diuretic agents, inotropic agents such as digoxin or dobutamine (Dobutrex), and dialysis. The metabolic acidosis of ESKD usually produces no symptoms and requires no treatment; however, sodium bicarbonate supplements or dialysis may be needed to correct the acidosis if it causes symptoms.

Anticonvulsant Agents

Neurologic abnormalities may occur, so the patient must be observed for early evidence of slight twitching, headache, delirium, or seizure activity. If seizures occur, the onset of the seizure is recorded along with the type, duration, and general effect on the patient. The primary provider is notified immediately. IV diazepam (Valium) or phenytoin is usually given to control seizures. The side rails of the bed should be raised and padded to protect the patient. See Chapter 49 for discussion of nursing management for the patient with seizures.

Erythropoietin

Anemia associated with ESKD is treated with erythrocyte-stimulating agents (recombinant human erythropoietin). Patients with anemia (hematocrit less than 30%) present with nonspecific symptoms, such as malaise, general fatigability, and decreased activity tolerance. Erythrocyte stimulation therapy is initiated to achieve a hematocrit of 33% to 38% and a target hemoglobin of 12 g/dL, which generally alleviates the symptoms of anemia.

Epoetin alfa is administered IV or subcutaneously three times a week in ESKD. It may take 2 to 6 weeks for the hematocrit to increase; therefore, the medication is not indicated for patients who need immediate correction of severe anemia. Adverse effects seen with erythropoietin therapy include hypertension (especially during early stages of treatment), increased clotting of vascular access sites, seizures, and depletion of body iron stores (Arslanian, 2015).

Management involves adjustment of heparin to prevent clotting of the lines during hemodialysis treatments, frequent monitoring of hemoglobin and hematocrit, and periodic assessment of serum iron and transferrin levels. Because adequate stores of iron are necessary for an adequate response to epoetin alfa, supplementary iron may be prescribed. Common iron supplements include iron sucrose (Venofer), iron dextran (INFeD or Dexferrum), and ferric gluconate (Ferrlecit). In addition, the patient's blood pressure and serum potassium level are monitored to detect hypertension and increasing serum potassium levels, which may occur with therapy and the

increasing RBC mass. The occurrence of hypertension requires initiation or adjustment of the patient's antihypertensive therapy. Hypertension that cannot be controlled is a contraindication to recombinant erythropoietin therapy.

Patients who have received erythropoietin therapy have reported decreased levels of fatigue, increased feelings of well-being, better tolerance of dialysis, higher-energy levels, and improved exercise tolerance. In addition, this therapy has decreased the need for transfusion and its associated risks, including blood-borne infectious disease, antibody formation, and iron overload.

Nutritional Therapy

Dietary intervention is necessary with deterioration of renal function and includes careful regulation of protein intake, fluid intake to balance fluid losses, sodium intake to balance sodium losses, and some restriction of potassium. At the same time, adequate caloric intake and vitamin supplementation must be ensured. Protein is restricted because urea, uric acid, and organic acids—the breakdown products of dietary and tissue proteins—accumulate rapidly in the blood when there is impaired renal clearance. The allowed protein must be of high biologic value (dairy products, eggs, meats). High–biologic-value proteins are those that are complete proteins and supply the essential amino acids necessary for growth and cell repair.

Usually, the fluid allowance per day is 500 to 600 mL more than the previous day's 24-hour urine output. Calories are supplied by carbohydrates and fat to prevent wasting. Vitamin supplementation is necessary because a protein-restricted diet does not provide the necessary complement of vitamins. In addition, the patient on dialysis may lose water-soluble vitamins during the dialysis treatment.

Hyperkalemia is usually prevented by ensuring adequate dialysis treatments with potassium removal and careful monitoring of diet, medications, and fluids for their potassium content. Sodium polystyrene sulfonate (Kayexalate), a cation-exchange resin, may be needed for acute hyperkalemia.

Dialysis

The patient with increasing symptoms of kidney disease is referred to a dialysis and transplantation center early in the course of progressive kidney disease. Dialysis is usually initiated when the patient cannot maintain a reasonable lifestyle with conservative treatment.

Nursing Management

The patient with ESKD requires astute nursing care to avoid the complications of reduced renal function and the stresses and anxieties of dealing with a life-threatening illness.

Nursing care is directed toward assessing fluid status and identifying potential sources of imbalance, implementing a dietary program to ensure proper nutritional intake within the limits of the treatment regimen, and promoting positive feelings by encouraging increased self-care and greater independence. It is extremely important to provide explanations and information to the patient and family concerning ESKD, treatment options, and potential complications. A great deal of emotional support is needed by the patient and family because of the numerous changes experienced. Specific interventions, along with rationale and evaluation criteria, are presented in more detail in the plan of nursing care for the patient with ESKD (see Chart 44-7).

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

The nurse plays an important role in educating the patient with ESKD. Because of the extensive education needed, the home care nurse, dialysis nurse, and nurses in the hospital and outpatient settings all provide ongoing education and reinforcement while monitoring the patient's progress and compliance with the treatment regimen.

A referral to a nutritionist is made because of the dietary changes required. The patient is instructed to check the vascular access device for patency and to use appropriate precautions, such as avoiding venipuncture and blood pressure measurements on the arm with the access device.

In addition, the patient and family need to know what problems to report to the primary provider. These include the following:

- Worsening signs and symptoms of kidney disease (nausea, vomiting, change in usual urine output [if any], ammonia odor on breath)
- Signs and symptoms of hyperkalemia (muscle weakness, diarrhea, abdominal cramps)
- Signs and symptoms of access problems (clotted fistula or graft, infection)

These signs and symptoms of decreasing renal function, in addition to increasing BUN and serum creatinine levels, may indicate a need to alter the dialysis prescription. The dialysis nurses also provide ongoing education and support at each treatment visit.

Continuing and Transitional Care

The importance of follow-up examinations and treatment is stressed with the patient and family because of changing physical status, renal function, and dialysis requirements. Referral for home care provides the home care nurse with the opportunity to assess the patient's environment, emotional status, and the coping strategies used by the patient and family to deal with the changes in family roles often associated with chronic illness.

The home care nurse also assesses the patient for further deterioration of renal function and signs and symptoms of complications resulting from the primary kidney disorder, the resulting kidney disease, and effects of treatment strategies (e.g., dialysis, medications, dietary restrictions) (Hain, 2015). Patients need education and reinforcement of the dietary restrictions required, including fluid, sodium, potassium, and protein restriction. Reminders about the need for health promotion activities and health screening are an important part of nursing care for the patient with kidney disease.

Gerontologic Considerations

Diabetes, hypertension, chronic glomerulonephritis, interstitial nephritis, and urinary tract obstruction are among the causes for ESKD in older adults. The signs and symptoms of kidney disease in older adults are often nonspecific. The occurrence of symptoms of other disorders (heart failure, dementia) can mask the symptoms of kidney disease and delay or prevent diagnosis and treatment.

Hemodialysis and PD are used effectively in treating older patients with ESKD. Initiation of dialysis among older patients has dramatically increased in the past decade. Implementation of palliative care has also increased among patients who choose not to start dialysis or who decide to stop dialysis. Although

Chart 44-7 PLAN OF NURSING CARE

The Patient with End-Stage Kidney Disease

NURSING DIAGNOSIS: Excess fluid volume related to decreased urine output, dietary excesses, and retention of sodium and water
GOAL: Maintenance of ideal body weight without excess fluid

Nursing Interventions	Rationale	Expected Outcomes
1. Assess fluid status: a. Daily weight b. Intake and output balance c. Skin turgor and presence of edema d. Distention of neck veins e. Blood pressure, pulse rate, and rhythm f. Respiratory rate and effort	1. Assessment provides baseline and ongoing database for monitoring changes and evaluating interventions.	• Demonstrates no rapid weight changes • Maintains dietary and fluid restrictions • Exhibits normal skin turgor without edema • Exhibits normal vital signs • Exhibits no neck vein distention
2. Limit fluid intake to prescribed volume.	2. Fluid restriction will be determined on basis of weight, urine output, and response to therapy.	• Reports no difficulty breathing or shortness of breath • Performs oral hygiene frequently
3. Identify potential sources of fluid: a. Medications and fluids used to take or administer medications: oral and IV b. Foods	3. Unrecognized sources of excess fluids may be identified.	• Reports decreased thirst • Reports decreased dryness of oral mucous membranes
4. Explain to patient and family the rationale for fluid restriction.	4. Understanding promotes patient and family cooperation with fluid restriction.	
5. Assist patient to cope with the discomforts resulting from fluid restriction.	5. Increasing patient comfort promotes compliance with dietary restrictions.	
6. Provide or encourage frequent oral hygiene.	6. Oral hygiene minimizes dryness of oral mucous membranes.	

NURSING DIAGNOSIS: Imbalanced nutrition: less than body requirements related to anorexia, nausea, vomiting, dietary restrictions, and altered oral mucous membranes
GOAL: Maintenance of adequate nutritional intake

Nursing Interventions	Rationale	Expected Outcomes
1. Assess nutritional status: a. Weight changes b. Laboratory values (serum electrolyte, blood urea nitrogen [BUN], creatinine, protein, transferrin, and iron levels) (see Appendix A)	1. Baseline data allow for monitoring of changes and evaluating effectiveness of interventions.	• Consumes protein of high biologic value • Chooses foods within dietary restrictions that are appealing • Consumes high-calorie foods within dietary restrictions
2. Assess patient's nutritional dietary patterns: a. Diet history b. Food preferences c. Calorie counts	2. Past and present dietary patterns are considered in planning meals.	• Explains in own words rationale for dietary restrictions and relationship to urea and creatinine levels
3. Assess for factors contributing to altered nutritional intake: a. Anorexia, nausea, or vomiting b. Diet unpalatable to patient c. Depression d. Lack of understanding of dietary restrictions e. Stomatitis	3. Information about other factors that may be altered or eliminated to promote adequate dietary intake is provided.	• Takes medications on schedule that does not produce anorexia or feeling of fullness • Consults written lists of acceptable foods • Reports increased appetite at meals • Exhibits no rapid increases or decreases in weight
4. Provide patient's food preferences within dietary restrictions.	4. Increased dietary intake is encouraged.	• Demonstrates normal skin turgor without edema; wound healing and acceptable plasma albumin levels
5. Promote intake of high–biologic-value protein foods: eggs, dairy products, meats.	5. Complete proteins are provided for positive nitrogen balance needed for growth and healing.	
6. Encourage high-calorie, low-protein, low-sodium, and low-potassium snacks between meals.	6. Reduces source of restricted foods and proteins and provides calories for energy, sparing protein for tissue growth and healing.	
7. Alter schedule of medications so that they are not given immediately before meals.	7. Ingestion of medications just before meals may produce anorexia and feeling of fullness.	
8. Explain rationale for dietary restrictions and relationship to kidney disease and increased urea and serum creatinine levels.	8. Promotes patient understanding of relationships between diet and urea and creatinine levels to kidney disease.	

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9. Provide written lists of foods allowed and suggestions for improving their taste without the use of sodium or potassium.	9. Lists provide a positive approach to dietary restrictions and a reference for patient and family to use when at home.	
10. Provide pleasant surroundings at mealtimes.	10. Unpleasant factors that contribute to patient's anorexia are eliminated.	
11. Weigh patient daily.	11. Allows monitoring of fluid and nutritional status.	
12. Assess for evidence of inadequate protein intake: a. Edema formation b. Delayed wound healing c. Decreased serum albumin levels	12. Inadequate protein intake can lead to decreased albumin and other proteins, edema formation, and delay in wound healing.	

NURSING DIAGNOSIS: Deficient knowledge regarding condition and treatment
GOAL: Increased knowledge about condition and related treatment

Nursing Interventions	Rationale	Expected Outcomes
1. Assess understanding of cause of kidney disease, consequences of kidney disease, and its treatment: a. Cause of patient's kidney disease b. Meaning of kidney disease c. Understanding of renal function d. Relationship of fluid and dietary restrictions to kidney disease e. Rationale for treatment (hemodialysis, peritoneal dialysis, transplantation)	1. Provides baseline for further explanations and education.	• Verbalizes relationship of cause of kidney disease to consequences • Explains fluid and dietary restrictions as they relate to failure of kidney's regulatory functions • States in own words relationship of kidney disease and need for treatment • Asks questions about treatment options, indicating readiness to learn • Verbalizes plans to continue as normal a life as possible • Uses written information and instructions to clarify questions and seek additional information
2. Provide explanation of renal function and consequences of kidney disease at patient's level of understanding and guided by patient's readiness to learn.	2. Patient can learn about kidney disease and treatment as they become ready to understand and accept the diagnosis and consequences.	
3. Assist patient to identify ways to incorporate changes related to illness and its treatment into lifestyle.	3. Patient can see that their life does not have to revolve around the disease.	
4. Provide oral and written information as appropriate about: a. Renal function and failure b. Fluid and dietary restrictions c. Medications d. Reportable problems, signs, and symptoms e. Follow-up schedule f. Community resources g. Treatment options	4. Provides patient with information that can be used for further clarification at home.	

NURSING DIAGNOSIS: Activity intolerance related to fatigue, anemia, retention of waste products, and dialysis procedure
GOAL: Participation in activity within tolerance

Nursing Interventions	Rationale	Expected Outcomes
1. Assess factors contributing to activity intolerance: a. Fatigue b. Anemia c. Fluid and electrolyte imbalances d. Retention of waste products e. Depression	1. Indicates factors contributing to severity of fatigue.	• Participates in increasing levels of activity and exercise • Reports increased sense of well-being • Alternates rest and activity • Participates in selected self-care activities
2. Promote independence in self-care activities as tolerated; assist if fatigued.	2. Promotes improved self-esteem.	
3. Encourage alternating activity with rest.	3. Promotes activity and exercise within limits and adequate rest.	
4. Encourage patient to rest after dialysis treatments.	4. Adequate rest is encouraged after dialysis treatments, which are exhausting to many patients.	

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NURSING DIAGNOSIS: Risk for situational low self-esteem related to dependency, role changes, change in body image, and change in sexual function
GOAL: Improved self-esteem

Nursing Interventions	Rationale	Expected Outcomes
1. Assess patient's and family's responses and reactions to illness and treatment.	1. Provides data about problems encountered by patient and family in coping with changes in life.	• Identifies previously used coping styles that have been effective and those no longer possible due to disease and treatment (alcohol or drug use; extreme physical exertion)
2. Assess relationship of patient and significant family members.	2. Identifies strengths and supports of patient and family.	
3. Assess usual coping patterns of patient and family members.	3. Coping patterns that may have been effective in past may be harmful in view of restrictions imposed by disease and treatment.	• Patient and family identify and verbalize feelings and reactions to disease and necessary changes in their lives
4. Encourage open discussion of concerns about changes produced by disease and treatment: a. Assess factors contributing to activity intolerance: Role changes b. Assess factors contributing to activity intolerance: Changes in lifestyle c. Assess factors contributing to activity intolerance: Changes in occupation d. Assess factors contributing to activity intolerance: Sexual changes e. Assess factors contributing to activity intolerance: Dependence on health care team	4. Encourages patient to identify concerns and steps necessary to deal with them.	• Seeks professional counseling, if necessary, to cope with changes resulting from kidney disease • Reports satisfaction with method of sexual expression
5. Explore alternate ways of sexual expression other than sexual intercourse.	5. Alternative forms of sexual expression may be acceptable.	
6. Discuss role of giving and receiving love, warmth, and affection.	6. Sexuality means different things to different people, depending on stage of maturity.	

COLLABORATIVE PROBLEMS: Hyperkalemia; pericarditis, pericardial effusion, and pericardial tamponade; hypertension; anemia; bone disease and metastatic calcifications
GOAL: Absence of complications

Nursing Interventions	Rationale	Expected Outcomes
Hyperkalemia		
1. Monitor serum potassium levels. Notify primary provider if level is at or approaching >5.5 mEq/L, and prepare to treat hyperkalemia.	1. Hyperkalemia causes potentially life-threatening changes in the body.	• Has normal potassium level • Experiences no muscle weakness or diarrhea
2. Assess patient for muscle weakness, diarrhea, electrocardiographic (ECG) changes (tall-tented T waves and widened QRS).	2. Cardiovascular signs and symptoms are characteristic of hyperkalemia.	• Exhibits normal ECG pattern • Vital signs are within normal limits
Pericarditis, Pericardial Effusion, and Pericardial Tamponade		
1. Assess patient for fever, chest pain, and a pericardial friction rub (signs of pericarditis); if present, notify primary provider.	1. About 30–50% of patients with chronic kidney disease develop pericarditis due to uremia; fever, chest pain, and a pericardial friction rub are classic signs.	• Has strong and equal peripheral pulses • Absence of a paradoxical pulse • Absence of pericardial effusion or tamponade on cardiac ultrasound
2. If patient has pericarditis, assess for the following every 4 hours: a. Paradoxical pulse, >10 mm Hg b. Extreme hypotension c. Weak or absent peripheral pulses d. Altered level of consciousness e. Jugular venous distention	2. Pericardial effusion is a common fatal sequela of pericarditis. Signs of an effusion include a paradoxical pulse (>10 mm Hg drop in blood pressure during inspiration) and signs of shock due to compression of the heart by a large effusion. Cardiac tamponade exists when the patient is severely compromised hemodynamically.	• Has normal heart sounds
3. Prepare patient for echocardiogram to aid in diagnosis of pericardial effusion and cardiac tamponade.	3. Echocardiogram is useful in visualizing pericardial effusions and cardiac tamponade.	

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4. If cardiac tamponade develops, prepare patient for emergency pericardiocentesis.	4. Cardiac tamponade is a life-threatening condition, with a high mortality rate. Immediate aspiration of fluid from the pericardial space is essential.	
Hypertension		
1. Monitor and record blood pressure as indicated.	1. Provides objective data for monitoring. Elevated levels may indicate nonadherence to the treatment regimen.	• Blood pressure within normal limits • Reports no headaches, visual problems, or seizures • Edema is absent
2. Administer antihypertensive medications as prescribed.	2. Antihypertensive medications play a key role in treatment of hypertension associated with chronic kidney disease.	• Demonstrates adherence to dietary and fluid restrictions
3. Encourage adherence to dietary and fluid restriction therapy.	3. Adherence to diet and fluid restrictions and dialysis schedule prevents excess fluid and sodium accumulation.	
4. Instruct patient to report signs of fluid overload, vision changes, headaches, edema, or seizures.	4. These are indications of inadequate control of hypertension and the need to alter therapy.	
Anemia		
1. Monitor red blood cell (RBC) count and hemoglobin and hematocrit levels as indicated.	1. Provides assessment of degree of anemia.	• Patient has a normal skin color without pallor
2. Administer medications as prescribed, including iron and folic acid supplements, an erythrocyte stimulating agent, and multivitamins.	2. RBCs need iron, folic acid, and vitamins to be produced. An erythrocyte-stimulating agent stimulates the bone marrow to produce RBCs.	• Exhibits hemoglobin levels within acceptable limits • Experiences no bleeding from any site
3. Avoid drawing unnecessary blood specimens.	3. Anemia is worsened by drawing numerous specimens.	
4. Educate patient to prevent bleeding: Avoid vigorous nose blowing and contact sports, and use a soft toothbrush.	4. Bleeding from anywhere in the body worsens anemia.	
5. Administer blood component therapy as indicated.	5. Blood component therapy may be needed if the patient has symptoms.	
Bone Disease and Metastatic Calcifications		
1. Administer the following medications as prescribed: phosphate binders, calcium supplements, vitamin D supplements.	1. Chronic kidney disease causes numerous physiologic changes affecting calcium, phosphorus, and vitamin D metabolism.	• Exhibits serum calcium, phosphorus, and aluminum levels within acceptable ranges • Exhibits no symptoms of hypocalcemia
2. Monitor serum laboratory values as indicated (calcium, phosphorus, aluminum levels), and report abnormal findings to primary provider.	2. Hyperphosphatemia, hypocalcemia, and excess aluminum accumulation are common in chronic kidney disease.	• Has no bone demineralization on bone scan
3. Assist patient with an exercise program.	3. Bone demineralization increases with immobility.	• Discusses importance of maintaining activity level and exercise program

there is no specific age limitation for kidney transplantation, concomitant disorders (e.g., coronary artery disease, peripheral vascular disease) have made it a less common treatment for older adults. However, the outcome is comparable to that in younger patients. Some older patients elect not to undergo dialysis or transplantation. Conservative management and palliative care, including nutritional therapy, fluid control, and medications such as phosphate binders, may be considered in patients who are not suitable for or elect not to have dialysis or transplantation (Prentice, 2013). Palliative care for the patient with ESKD focuses on relieving suffering, promoting health-related quality of life, and facilitating dignity at the end of life (see Chapter 59).

RENAL REPLACEMENT THERAPIES

The use of renal replacement therapies becomes necessary when the kidneys can no longer remove wastes, maintain electrolytes, and regulate fluid balance. This can occur rapidly or over a long period of time, and the need for replacement therapy can be acute (short term) or chronic (long term). The main renal replacement therapies include the various types of dialysis and kidney transplantation.

Dialysis

Types of dialysis include hemodialysis, CRRT, and PD. Acute or urgent dialysis is indicated when there is a high

and increasing level of serum potassium, fluid overload, or impending pulmonary edema; increasing acidosis; pericarditis; and advanced uremia (Grossman & Porth, 2014). It may also be used to remove medications or toxins (poisoning or medication overdose) from the blood or for edema that does not respond to other treatment, hepatic coma, hyperkalemia, hypercalcemia, hypertension, and uremia.

Chronic or maintenance dialysis is indicated in advanced CKD and ESKD in the following instances: the presence of uremic signs and symptoms affecting all body systems (nausea and vomiting, severe anorexia, increasing lethargy, mental confusion), hyperkalemia, fluid overload not responsive to diuretics and fluid restriction, and a general lack of well-being. An urgent indication for dialysis in patients with kidney disease is pericardial friction rub, which is indicative of uremic pericarditis.

The decision to initiate dialysis should be reached only after thoughtful discussion among the patient, family, primary provider, and other health care team members. The nurse can assist the patient and family by answering their questions, clarifying the information provided, and supporting their decision.

Successful kidney transplantation eliminates the need for dialysis. Not only is the quality of life much improved in patients with ESKD who undergo transplantation, but physiologic function is improved as well. Patients who undergo kidney transplantation from living donors before dialysis is initiated generally have longer survival of the transplanted kidney than patients who receive transplantation after dialysis treatment is initiated (Trevitt, Dunsmore, Murphy, et al., 2012).

Hemodialysis

Hemodialysis is used for patients who are acutely ill and require short-term dialysis for days to weeks until kidney function resumes and for patients with advanced CKD and ESKD who require long-term or permanent renal replacement therapy. Hemodialysis prevents death but does not cure kidney disease and does not compensate for the loss of endocrine or metabolic activities of the kidneys. More than 90% of patients requiring long-term renal replacement therapy are on chronic hemodialysis (USRDS, 2015). Most patients receive intermittent hemodialysis that involves treatments three times a week with an average treatment duration of 3 to 5 hours in an outpatient setting. Hemodialysis can also be performed at home by the patient and a caregiver. With home dialysis, treatment time and frequency can be adjusted to meet optimal patient needs.

The objectives of hemodialysis are to extract toxic nitrogenous substances from the blood and to remove excess fluid. A dialyzer (also referred to as an artificial kidney) is a synthetic semipermeable membrane through which blood is filtered to remove uremic toxins and a desired amount of fluid. In hemodialysis, the blood, laden with toxins and nitrogenous wastes, is diverted from the patient to a machine via the use of a blood pump to the dialyzer, where toxins are filtered from the blood and the blood is returned to the patient.

Diffusion, osmosis, and ultrafiltration are the principles on which hemodialysis is based (see Chapter 7). The toxins and wastes in the blood are removed by diffusion—that is, they move from an area of higher concentration in the blood to an area of lower concentration in the dialysate. The dialysate is a solution that circulates through the dialyzer, made up of all the electrolytes in their ideal extracellular concentrations. The electrolyte level in the patient's blood can be brought under control by properly adjusting the electrolytes in the dialysate solution. The semipermeable membrane impedes the diffusion of large molecules, such as RBCs and proteins.

Excess fluid is removed from the blood by osmosis, in which water moves from an area of low concentration potential (the blood) to an area of high concentration potential (the dialysate bath). In **ultrafiltration**, fluid moves under high pressure to an area of lower pressure. This process is much more efficient than osmosis for fluid removal and is accomplished by applying negative pressure or a suctioning force to the dialysis membrane. Because patients with disease requiring dialysis usually cannot excrete water, this force is necessary to remove fluid to achieve fluid balance.

The body's buffer system is maintained using a dialysate bath made up of bicarbonate (most common) or acetate, which is metabolized to form bicarbonate. The anticoagulant heparin is given to keep blood from clotting in the extracorporeal dialysis circuit. Cleansed blood is returned to the body with the goal of removing fluid, balancing electrolytes, and managing acidosis.

Dialyzers

Dialyzers are hollow-fiber devices containing thousands of tiny capillary tubes that carry the blood through the artificial kidney. The tubes are porous and act as a semipermeable membrane, allowing toxins, fluid, and electrolytes to pass across the membrane. The constant flow of the solution maintains the concentration gradient to facilitate the exchange of wastes from the blood across the semipermeable membrane into the dialysate solution, where they are removed and discarded (see Fig. 44-5).

Dialyzers have undergone many technologic changes in performance and biocompatibility. High-flux dialysis uses highly permeable membranes to increase the clearance of low- and mid–molecular-weight molecules. These special membranes are used with higher than traditional rates of flow for the blood entering and exiting the dialyzer (500 to 550 mL/min). High-flux dialysis increases the efficiency of treatments while shortening their duration and reducing the need for heparin.

Vascular Access

Access to the patient's vascular system must be established to allow blood to be removed, cleansed, and returned to the patient's vascular system at the rapid rates of 300 and 800 mL/min. Several types of access can be surgically created or placed during procedures performed in interventional radiology suites or at the bedside.

Vascular Access Devices

Immediate access to the patient's circulation for acute hemodialysis is achieved by inserting a double-lumen, noncuffed, large-bore catheter into the subclavian, internal jugular, or femoral vein by the physician (see Fig. 44-6). This method of vascular access involves some risk (e.g., hematoma, pneumothorax, infection, thrombosis of the subclavian vein, inadequate flow). The catheter is removed when no longer needed (e.g., because the patient's condition has improved or another type of permanent access has been established). Double-lumen, cuffed catheters may also be inserted, usually by either a surgeon or interventional radiologist, into the internal jugular vein of the patient. Because these catheters have cuffs under the skin, the insertion site heals, sealing the wound and reducing the risk for ascending infection. This feature makes these catheters safe for longer-term use. However, infection rates remain high, and sepsis continues to be a common cause for hospital admission (Figueiredo, 2014).

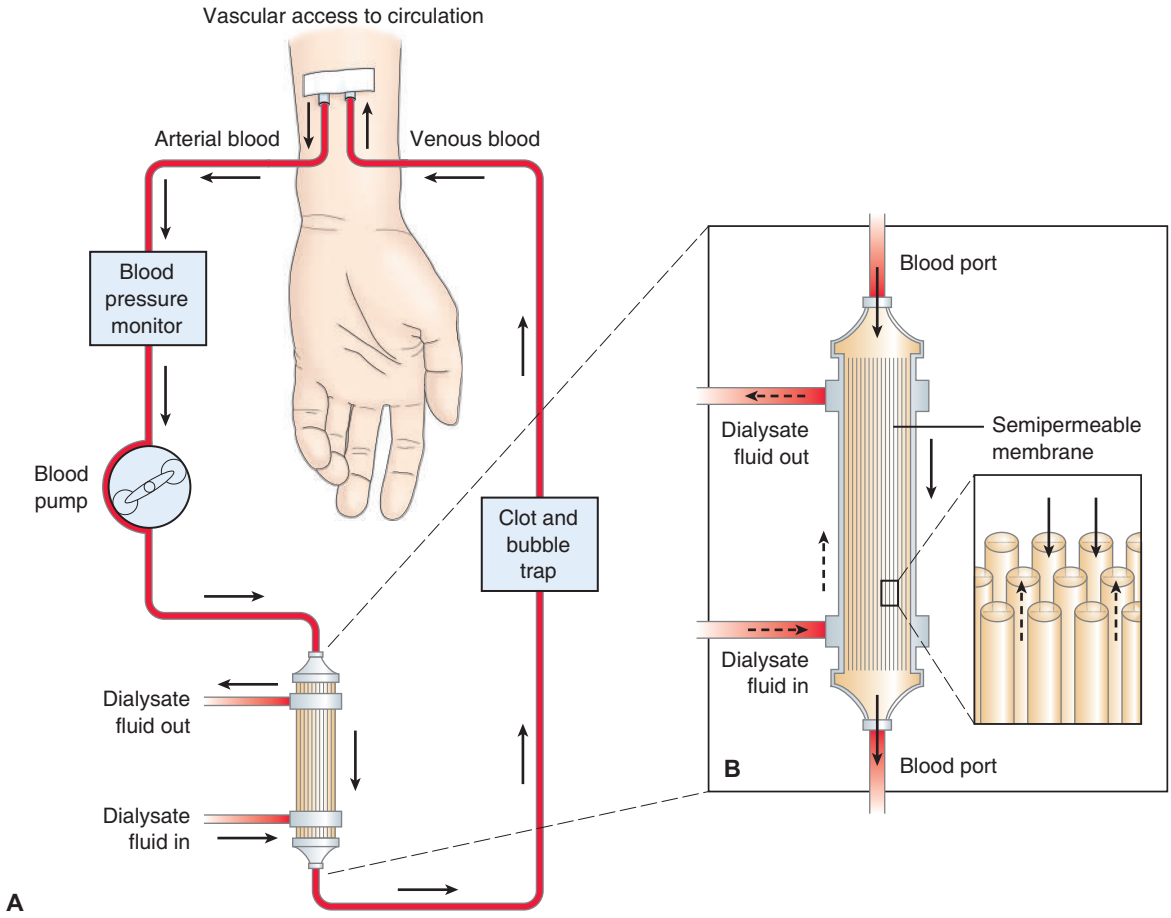


Figure 44-5 • Hemodialysis system. Blood from an artery is pumped (**A**) into a dialyzer, where it flows through the synthetic capillary tubes (**B**), which act as the semipermeable membrane (*inset*). The dialysate, which has a particular chemical composition, flows into the dialyzer around the capillary tubes that the blood flows through. The waste products in the blood diffuse across the semipermeable membrane into the dialysate solution.

Arteriovenous Fistula

The preferred method of permanent vascular access for dialysis is an arteriovenous fistula (AVF) that is created surgically (usually in the forearm) by joining (anastomosing) an artery to a vein, either side to side or end to side (see Fig. 44-7A). Needles are inserted into the vessel to obtain blood flow adequate to pass through the dialyzer. The arterial segment of the fistula is used for arterial flow to the dialyzer and the venous segment for reinfusion of the dialyzed blood. This access will need time (2 to 3 months) to "mature" before it can be used. As the AVF matures, the venous segment dilates due to the increased blood flow coming directly from the artery. Once sufficiently dilated, it will then accommodate two large-bore (14-, 15-, or 16-gauge) needles that are inserted for each dialysis treatment. The patient is encouraged to perform hand exercises to increase the size of these vessels (i.e., squeezing a rubber ball for forearm fistulas) to accommodate the large-bore needles. Once established, this access has the longest useful life and thus is the best option for vascular access for the patient requiring ongoing hemodialysis (MacRae, Ahmed, & Hemmelgam, 2014).

Arteriovenous Graft

An arteriovenous graft can be created by subcutaneously interposing a biologic, semibiologic, or synthetic graft material between an artery and vein (see Fig. 44-7B). Usually, a graft is created when the patient's vessels are not suitable for creation of an AVF. Patients with compromised vascular systems (e.g., from diabetes) often require a graft because their native vessels may not be suitable for creation of an AVF. Grafts are usually placed in the arm but may be placed in the thigh or chest wall. Stenosis, infection, and thrombosis are the most common complications of this access. It is not at all uncommon to see a dialysis patient with numerous "old" or "nonfunctioning" accesses present on their arms. The patient is asked to identify the current access in use, and it is checked carefully for the presence of a bruit and thrill.

See the Special Considerations: Nursing Management of the Patient on Dialysis Who Is Hospitalized section later in this chapter for nursing interventions and care of the patient with an arteriovenous graft or fistula.

Nursing Alert: Failure of the permanent dialysis access (fistula or graft) accounts for most hospital admissions of patients undergoing chronic hemodialysis. Thus, protection of the access is of high priority.

Complications

Although hemodialysis can prolong life, it does not alter the natural course of the underlying CKD, nor does it completely replace kidney function. The CKD complications previously

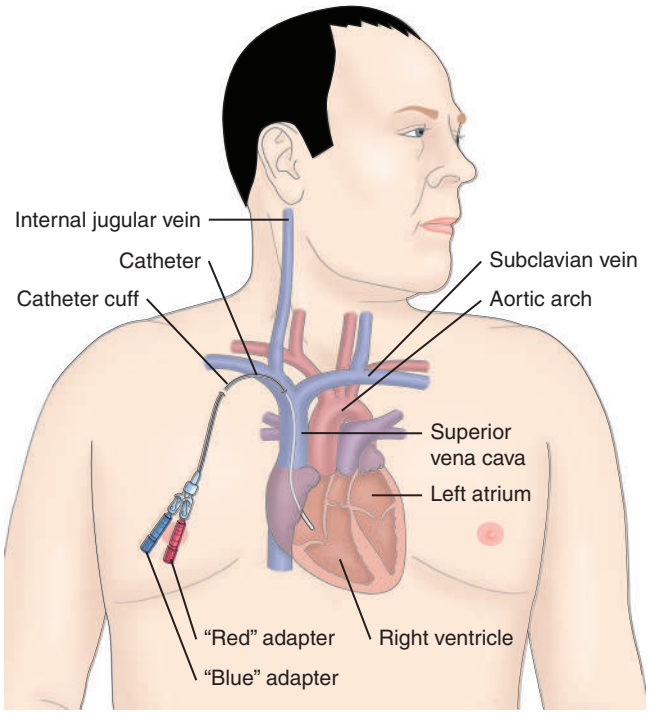


Figure 44-6 • Double-lumen, cuffed hemodialysis catheter used in acute hemodialysis. The red lumen is attached to a blood line through which blood is pumped from the patient to the dialyzer. After the blood passes through the dialyzer (artificial kidney), it returns to the patient through the blue lumen of the catheter.

discussed will continue to worsen and require treatment. With the initiation of dialysis, disturbances of lipid metabolism (hypertriglyceridemia) are accentuated and contribute to cardiovascular complications. Heart failure, coronary artery disease, angina, stroke, and peripheral vascular disease may occur and can incapacitate the patient. Cardiovascular disease remains the leading cause of death in patients receiving dialysis (Deng & Forbes, 2015); (Ludvigsen, Hermansen, & Lindberg, 2014).

Anemia is compounded by blood lost during hemodialysis. Gastric ulcers may result from the physiologic stress of chronic illness, medication, and pre-existing medical conditions (e.g., diabetes). Patients with uremia report a metallic taste and nausea when they require dialysis. Vomiting may occur during the hemodialysis treatment when rapid fluid shifts and hypotension occur. These contribute to the malnutrition seen in patients on dialysis. Poor calcium metabolism and renal osteodystrophy can result in bone pain and fractures, interfering with mobility. As time on dialysis continues, calcification of major blood vessels has been reported and linked to hypertension and other vascular complications. Phosphorus deposits in the skin can occur and cause itching.

Many people undergoing hemodialysis experience major sleep problems that further complicate their overall health status. Early-morning or late-afternoon dialysis may be a risk factor for developing sleep disturbances.

Other complications of dialysis treatment may include the following:

- Episodes of shortness of breath often occur as fluid accumulates between dialysis treatments.
- Hypotension may occur during the treatment as fluid is removed. Nausea and vomiting, diaphoresis, tachycardia, and dizziness are common signs of hypotension.

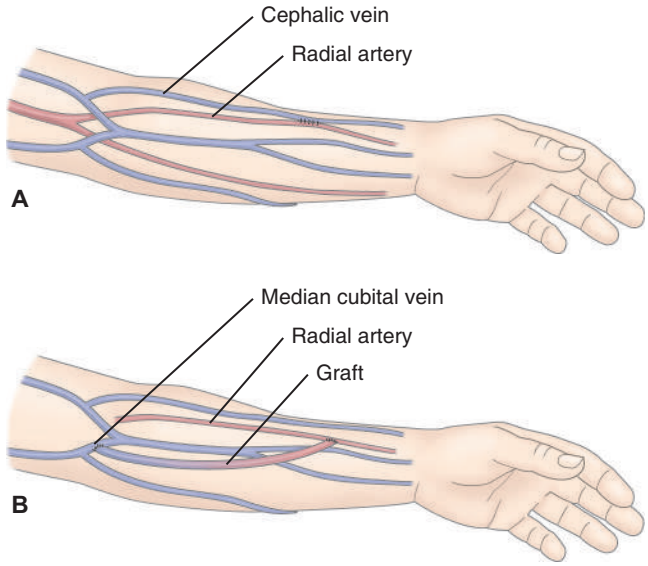


Figure 44-7 • **A.** Arteriovenous fistulas are created by anastomosing a patient's vein to an artery. This illustrates a side-to-side anastomosis. **B.** Arteriovenous grafts are established by connecting the artery and vein using synthetic tubing.

- Painful muscle cramping may occur, usually late in dialysis as fluid and electrolytes rapidly leave the extracellular space.
- Exsanguination may occur if blood lines separate or dialysis needles become dislodged.
- Dysrhythmias may result from electrolyte and pH changes or from removal of antiarrhythmic medications during dialysis.
- Air embolism is rare but can occur if air enters the vascular system.
- Chest pain may occur in patients with anemia or arteriosclerotic heart disease.
- Dialysis disequilibrium results from cerebral fluid shifts. Signs and symptoms include headache, nausea and vomiting, restlessness, decreased level of consciousness, and seizures. It is rare and more likely to occur in AKI or when BUN levels are very high (exceeding 150 mg/dL).

Nursing Management

The nurse in the dialysis unit has an important role in monitoring, supporting, assessing, and educating the patient. During dialysis, the patient, the dialyzer, and the dialysate bath require constant monitoring because numerous complications are possible, including clotting of the dialysis tubing or dialyzer, air embolism, inadequate or excessive fluid removal, hypotension, cramping, vomiting, blood leaks, contamination, and access complications. Nursing care of the patient and maintenance of the vascular access device are especially important and are discussed in the Special Considerations: Nursing Management of the Patient on Dialysis Who Is Hospitalized section.

Promoting Pharmacologic Therapy

Many medications are removed from the blood during hemodialysis; therefore, dosage or timing of the medication administration may require adjustment. Medications that are water soluble are readily removed during hemodialysis treatment, and those that are fat soluble or adhere to other substances (like albumin) are not dialyzed out very well. This is the reason some drug overdoses are treated with emergency hemodialysis and others are not.

Patients undergoing hemodialysis who require medications (e.g., cardiac glycosides, antibiotic agents, antiarrhythmic medications, antihypertensive agents) are monitored closely to ensure that blood and tissue levels of these medications are maintained without toxic accumulation. Antihypertensive therapy, often part of the regimen of patients on dialysis, is one example when communication, education, and evaluation can make a difference in patient outcomes. The patient must know when—and when not—to take the medication. For example, if an antihypertensive agent is taken on a dialysis day, hypotension may occur during dialysis, causing dangerously low blood pressure. Many medications that are taken once daily can be held until after the dialysis treatment.

Promoting Nutritional and Fluid Therapy

Diet is important for patients on hemodialysis because of the effects of uremia. Goals of nutritional therapy are to minimize uremic symptoms and fluid and electrolyte imbalances; to maintain good nutritional status through adequate protein, calorie, vitamin, and mineral intake; and to enable the patient to eat a palatable and enjoyable diet. Restricting dietary protein decreases the accumulation of nitrogenous wastes, reduces uremic symptoms, and may even postpone the initiation of dialysis for a few months. Restriction of fluid is also part of the dietary prescription because fluid accumulation may occur, leading to weight gain, heart failure, and pulmonary edema.

With the initiation of hemodialysis, the patient usually requires some restriction of dietary protein, sodium, potassium, phosphorus, and fluid intake. Protein intake is restricted to about 1.2 to 1.3 g/kg ideal body weight per day; therefore, protein must be of high biologic quality. Sodium is usually restricted to 2 to 3 g/day; fluids are restricted to an amount equal to the daily urine output plus 500 mL/day. The goal for patients on hemodialysis is to keep their interdialytic (between dialysis treatments) weight gain under 1.5 kg. Potassium restriction depends on the amount of residual renal function and the frequency of dialysis. Dietary restriction is an unwelcome change in lifestyle for many patients with ESKD. Patients can feel stigmatized in social situations because there may be few food choices available for their diet. If the restrictions are ignored, life-threatening complications, such as hyperkalemia and pulmonary edema, may result. Thus, the patient may feel punished for responding to basic human drives to eat and drink. The nurse who cares for a patient with symptoms or complications resulting from dietary indiscretion must avoid harsh, judgmental, or punitive tones when communicating with him or her. Regular education with reinforcement is needed to achieve these difficult changes in lifestyle.

Meeting Psychosocial Needs

Patients requiring long-term hemodialysis are often concerned about the unpredictability of the illness and the quality of their lives (Wright & Wilson, 2015). They often have financial problems, difficulty holding a job, waning sexual desire and impotence, clinical depression, and fear of dying. Younger patients worry about marriage, having children, and the burden that they bring to their families. The regimented lifestyle that frequent dialysis treatments and restrictions in food and fluid intake impose can be demoralizing to the patient and family. Researchers have studied the quality of life and self-efficacy in patient undergoing dialysis (see Chart 44-8).

Dialysis alters the lifestyle of the patient and family. The amount of time required for dialysis and primary provider visits and being chronically ill can create conflict, frustration, guilt, and depression. It may be difficult for the patient, spouse, and family to express anger and negative feelings.

The nurse needs to give the patient and family the opportunity to express feelings of anger and concern about the limitations that the disease and treatment impose, possible financial problems, and job insecurity. If anger is not expressed, it may be directed inward and lead to depression, despair, and attempts at suicide (suicide is more prevalent in patients on dialysis); however, if anger is projected outward to other people, it may damage family relationships.

Although these feelings are normal in this situation, they are often profound. Counseling and psychotherapy may be useful. Depression may require treatment with antidepressant agents. Referring the patient and family to a mental health provider with expertise in the care of patients receiving dialysis may also be helpful. Clinical nurse specialists, psychologists, and social workers

Chart 44-8 NURSING RESEARCH PROFILE

Quality of Life in Patients Receiving Dialysis

Wright, L. S. & Wilson, L. (2015). Quality of life and self-efficacy in three dialysis modalities: Incenter hemodialysis, home hemodialysis, and home peritoneal dialysis. Nephrology Nursing Journal, 42(5), 463–476.

Purpose

Previous research has focused almost exclusively on the quality of life among patients receiving incenter hemodialysis (HD). The purpose of this study was to describe the quality of life and self-efficacy of patients receiving incenter HD compared to those receiving a home HD (HD or peritoneal dialysis [PD]).

Design

This study utilized a correlational cross-sectional design and quota sampling to achieve equal group size. Patients were recruited from outpatient dialysis facilities and included 77 community dwelling adult patients who had been on dialysis for at least 6 months. Quality of life was measured using the Kidney Disease Quality of Life (QOL) Instrument, and self-efficacy was measured using the Strategies Used by People to Promote Health instrument.

Findings

The sample included 29 participants receiving incenter HD treatments, 22 on home HD, and 26 on home PD. There were no significant differences in demographic characteristics. Participants on PD scored the highest in 6 of the 11 CKD-specific to QOL measures. Patients on PD also scored highest in 8 of the 9 generic QOL measures. The results of this study suggest a possible benefit for patients on PD with regard to QOL and self-efficacy.

Nursing Implications

This information helps nurses to understand patient needs, both medical and social, and to recognize their key role in educating patients about treatment options and other care-related issues. By knowing the differences in reported self-efficacy and QOL across dialysis modalities, nurses can help empower patients to make decisions about which mode of dialysis treatment will meet their individual needs.

may be helpful in assisting the patient and family to cope with the changes brought about by kidney disease and its treatment.

The sense of loss that the patient experiences cannot be underestimated because every aspect of a "normal life" is disrupted. Some patients use denial to deal with the array of medical problems (e.g., infections, hypertension, anemia, neuropathy). Staff who are tempted to label the patient as noncompliant must consider the impact of kidney disease and its treatment on the patient and family and the coping strategies that they may use.

Palliative care principles that focus on symptom control are becoming increasingly important as greater attention is focused on quality-of-life issues (Hain, 2015). Patients and their families are encouraged to discuss end-of-life options and to develop advanced directives or living wills.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

Preparing a patient for hemodialysis is essential. Assessment helps identify the learning needs of the patient and family members. In many cases, the patient is discharged home before learning needs and readiness to learn can be thoroughly evaluated; therefore, hospital-based nurses, dialysis staff, and home care nurses must work together to provide appropriate education that meets the patient's and family's changing needs and readiness to learn (see Chart 44-9).

The diagnosis of ESKD and the need for dialysis can be devastating for the patient and family. In addition, many patients with ESKD have clinical depression, a shortened attention span, a decreased level of concentration, and altered perception. Therefore, education must occur in brief, 10- to 15-minute sessions, with time added for clarification, repetition, reinforcement, and questions from the patient and family. The nurse needs to convey a nonjudgmental attitude to enable the patient and family to discuss options and their feelings about those options. Team conferences are helpful for sharing information and providing every team member the opportunity to discuss the needs of the patient and family.

Home Hemodialysis

Most patients who undergo hemodialysis do so in an outpatient setting, but home hemodialysis is an option for some. Home hemodialysis requires a highly motivated patient who is willing to take responsibility for the procedure and is able to adjust each treatment to meet the body's changing needs. It also requires the commitment and cooperation of a caregiver to assist the patient. However, many patients are not comfortable imposing on others this way and do not wish to subject family members to the feeling that their home is being turned into a clinic. The health care team never forces a patient to use home hemodialysis, because this treatment requires changes in the home and family. Home hemodialysis must be the patient's and family's decision (Wright & Wilson, 2015).

The patient undergoing home hemodialysis and the caregiver assisting that patient must be trained to prepare, operate, and disassemble the dialysis machine; maintain and clean the equipment; administer medications (e.g., heparin) into the machine lines; and handle emergency problems (hemodialysis dialyzer rupture, electrical or mechanical problems, hypotension, shock, and seizures) (Tennankore, d'Gama, Faratro, et al., 2015). Because home hemodialysis places primary responsibility for the treatment on the patient and the family member, they must understand and be capable of performing all aspects of the hemodialysis procedure.

Before home hemodialysis is initiated, the home environment, household and community resources, and ability and willingness of the patient and family to carry out this treatment are assessed. The home is surveyed to see if electrical outlets, plumbing facilities, and storage space are adequate. Modifications may be needed to enable the patient and assistant to perform dialysis safely and to deal with emergencies.

Once home hemodialysis is initiated, the home care nurse must visit periodically to evaluate compliance with the recommended techniques, to assess the patient for complications, to reinforce previous instruction, and to provide reassurance.

Continuing and Transitional Care

The health care team's goal in treating patients with CKD is to maximize their vocational potential, functional status, and quality of life (Wright & Wilson, 2015). To facilitate renal rehabilitation, appropriate follow-up and monitoring by members of the health care team (physicians, dialysis nurses,

Chart 44-9 HOME CARE CHECKLIST

The Patient Undergoing Hemodialysis

At the completion of education, the patient and/or caregiver will be able to:

- Discuss kidney disease and its effects on the body.
- State the goal and purpose of hemodialysis and its impact on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- Discuss common problems that may occur during hemodialysis and their prevention and management.
- State the name, dose, side effects, frequency, and schedule for all medications on dialysis and nondialysis days.
- Describe commonly measured laboratory values, results, and implications.
- State changes in lifestyle (e.g., diet, activity) necessary to maintain health.
  - Acknowledge dietary and fluid restrictions, rationale, and consequences of nonadherence.
  - State dietary restrictions and changes required to provide adequate protein, calorie, vitamin, and mineral intake.
- List guidelines for prevention and detection of fluid overload, meaning of "dry" weight, and how to weigh self.
- Demonstrate vascular access care, how to check patency, signs and symptoms of infection, and prevention of complications.
- Develop strategies to manage or reduce anxiety and maintain independence.
- Discuss strategies for detection, management, and relief of pruritus, neuropathy, and other potential complications of kidney disease.
- Relate how to reach primary provider with questions or complications.
- State time and date of follow-up medical appointments, therapy, and testing.
- Coordinate financial arrangements for hemodialysis and strategies to identify and obtain resources.
- Identify sources of support (e.g., friends, relatives, faith community, support groups, caregiver support).
- Identify the need for health promotion, disease prevention, and screening activities.

ADL, activities of daily living; IADL, independent activities of daily living.

social worker, psychologist, home care nurses, and others as appropriate) are essential to identify and resolve problems early on. Many patients with chronic kidney disease can resume relatively normal lives, doing the things that are important to them: traveling, exercising, working, or actively participating in family activities. If appropriate interventions are available early in the course of dialysis, the potential for better health improves, and the patient can remain active in family and community life. Outcome goals for renal rehabilitation include employment for those able to work, improved physical functioning of all patients, improved understanding about adaptation and options for living well, increased control over the effects of kidney disease and dialysis, and resumption of activities enjoyed before dialysis.

Continuous Renal Replacement Therapies

Continuous renal replacement therapies (CRRTs) may be indicated for patients with acute or chronic kidney disease who are too clinically unstable for traditional hemodialysis, for patients with fluid overload secondary to oliguric (low urine output) kidney disease, and for patients whose kidneys cannot handle their acutely high metabolic or nutritional needs. Some forms of CRRT may not require dialysis machines or dialysis personnel to carry out the procedures and can be initiated quickly. Several types of CRRT are available and widely used in critical care units (see Fig. 44-8). The methods are similar, as they require access to the circulation and blood to pass through an artificial filter. A hemofilter (an extremely porous blood filter containing a semipermeable membrane) is used in all types.

Continuous Venovenous Hemofiltration

Continuous venovenous hemofiltration (CVVH) is often used to manage AKI. Blood from a double-lumen venous catheter is pumped (using a small blood pump) through a hemofilter and then returned to the patient through the same catheter (Richardson & Whatmore, 2015). CVVH provides continuous slow fluid removal (**ultrafiltration**); therefore, hemodynamic effects are mild and better tolerated by patients with unstable conditions. CVVH requires a dual-lumen venous catheter and critical care nurses trained in management of the therapy who can set up, initiate, maintain, and terminate the system. Many hospitals have developed a collaborative approach to managing the CVVH therapy between the critical care and nephrology nursing staff.

Continuous Venovenous Hemodialysis

Continuous venovenous hemodialysis (CVVHD) is similar to CVVH. Blood is pumped from a double-lumen venous catheter through a hemofilter and returned to the patient through the same catheter. In addition to the benefits of **ultrafiltration**, CVVHD uses a concentration gradient to facilitate the removal of uremic toxins and fluid by adding a dialysate solution into the circuit. A dual-lumen venous catheter is required; hemodynamic effects are usually mild; and critical care nurses can set up, initiate, maintain, and terminate the system with the support of the nephrology nursing staff.

Peritoneal Dialysis

The goals of PD are to remove toxic substances and metabolic wastes and to reestablish normal fluid and electrolyte balance. PD may be the treatment of choice for patients with kidney disease who are unable or unwilling to undergo hemodialysis or kidney transplantation. Patients who are susceptible to the rapid fluid, electrolyte, and metabolic changes that occur during hemodialysis experience fewer of these problems with the slower rate of PD. Therefore, patients with diabetes or cardiovascular disease, many older patients, and those who may be at risk for

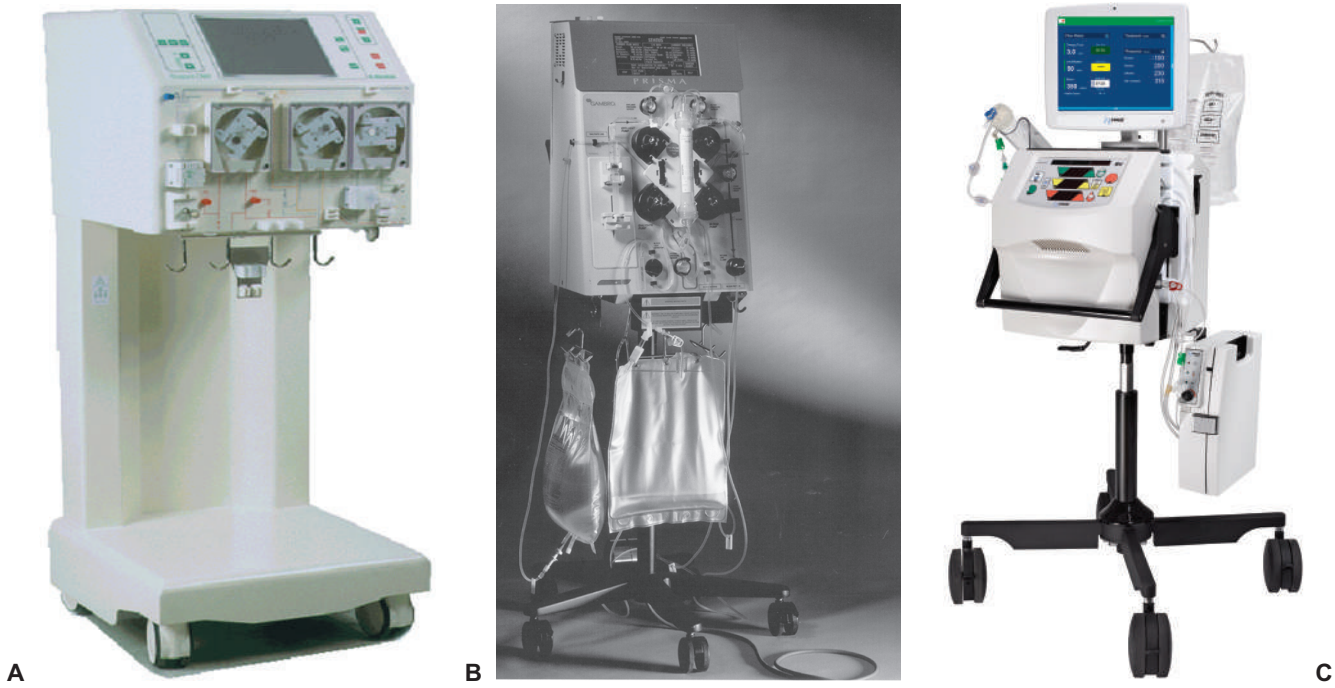


Figure 44-8 • Devices for administering continuous renal replacement therapy (CRRT) offer an integrated fluid warmer for the heating of infusion and dialysate fluids, a weighing system to reduce the possibility of error in assessing fluid balance, and a battery backup that allows treatments to continue when the patient is moved. **A.** Diapact CRRT System, B-Braun Medical, Inc., Bethlehem, PA. **B.** PRISMA, Gambro Corporation, Lakewood, CO. **C.** System One, NxStage Medical Inc., Lawrence, MA.

adverse effects of systemic heparin are likely candidates for PD. In addition, severe hypertension, heart failure, and pulmonary edema not responsive to usual treatment regimens have been successfully treated with PD. Fewer than 8% of patients with ESKD receive PD as their treatment modality (USRDS, 2015).

In PD, the peritoneal membrane that covers the abdominal organs and lines the abdominal wall serves as the semipermeable membrane. A sterile dextrose dialysate fluid is introduced into the peritoneal cavity through an abdominal catheter at established intervals (see Fig. 44-9). Once the sterile solution is in the peritoneal cavity, uremic toxins such as urea and creatinine begin to be cleared from the blood. Diffusion and osmosis occur as waste products move from an area of higher concentration (the bloodstream) to an area of lesser concentration (the dialysate fluid) through a semipermeable membrane (the peritoneum). This movement of solute from the blood into the dialysate fluid is called clearance. Because substances cross the peritoneal membrane at different rates, adjustments in solution dwell time in the peritoneal cavity and amount of fluid used are made to facilitate the process. **Ultrafiltration** (water removal) occurs in PD through an osmotic gradient created by using a dialysate fluid with a higher glucose concentration than the blood.

Procedure

As with other forms of treatment, the decision to begin PD is made by the patient and family in consultation with the primary provider. The patient may be acutely ill, thus requiring short-term treatment to correct severe disturbances in fluid and electrolyte status, or may have ESKD and need to receive ongoing treatments.

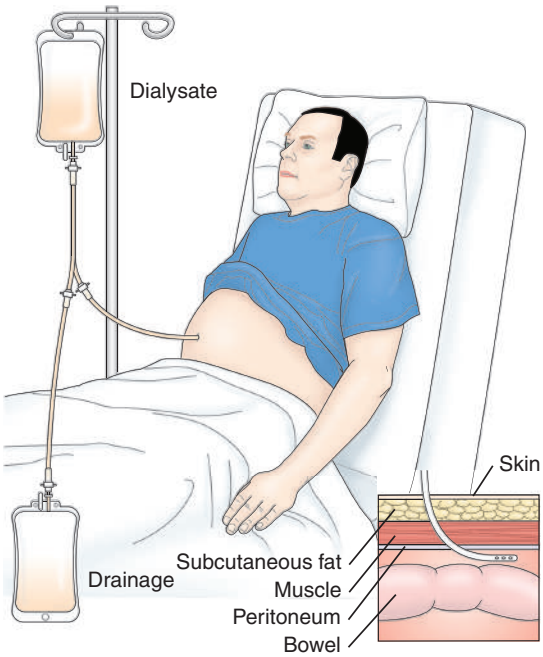


Figure 44-9 • In peritoneal dialysis and in acute intermittent peritoneal dialysis, dialysate is infused into the peritoneal cavity by gravity, after which the clamp on the infusion line is closed. After a dwell time (when the dialysate is in the peritoneal cavity), the drainage tube is unclamped and the fluid drains from the peritoneal cavity, again by gravity. A new container of dialysate is infused as soon as drainage is complete. The duration of the dwell time depends on the type of peritoneal dialysis.

Preparing the Patient

The nurse's preparation of the patient and family for PD depends on the patient's physical and psychological status, level of alertness, previous experience with dialysis, and understanding of and familiarity with the procedure.

The nurse explains the procedure to the patient and assists in obtaining signed consent for insertion of the catheter. Baseline vital signs, weight, and serum electrolyte levels are recorded. Evaluation of the abdomen for placement of the catheter is done to facilitate self-care. Typically, the catheter is placed on the nondominant side to allow the patient easier access to the catheter connection site when exchanges are done. The patient is encouraged to empty the bladder and bowel to reduce the risk of puncture of internal organs during the insertion procedure. Broad-spectrum antibiotic agents may be given to prevent infection. The peritoneal catheter can be inserted in interventional radiology, in the operating room, or at the bedside. Depending on the situation, this will need to be explained to the patient and family.

Preparing the Equipment

In addition to assembling the equipment for PD, the nurse consults with the physician to determine the concentration of dialysate to be used and the medications to be added. Heparin may be added to prevent fibrin formation and resultant occlusion of the peritoneal catheter. Potassium chloride may be prescribed to prevent hypokalemia. Antibiotic agents may be added to treat peritonitis (inflammation of the peritoneal membrane) caused by infection. Regular insulin may be added for patients with diabetes due to the high dextrose concentration of the PD solution. Aseptic technique is imperative whenever medications are added to the PD solution.

Before medications are added, the dialysate is warmed to body temperature to prevent patient discomfort and abdominal pain and to dilate the vessels of the peritoneum to increase urea clearance. Solutions that are too cold cause pain, cramping, and vasoconstriction and reduce clearance. Dry heating (heating cabinet, incubator, or heating pad) is recommended. Methods not recommended include soaking the bags of solution in warm water (can introduce bacteria to the exterior of the bags of solution and increase the chance of peritonitis) and the use of a microwave oven to heat the fluid (increases the danger of burning the peritoneum).

Immediately before initiating dialysis, using aseptic technique, the nurse assembles the administration set and tubing. The tubing is filled with the prepared dialysate to reduce the amount of air entering the catheter and peritoneal cavity, which could increase abdominal discomfort and interfere with instillation and drainage of the fluid.

Inserting the Catheter

Ideally, the peritoneal catheter is inserted in the operating room or radiology suite to maintain surgical asepsis and minimize the risk of contamination. Catheters for long-term use are usually soft and flexible and made of silicone with a radiopaque strip to permit visualization on x-ray. These catheters have three sections: (1) an intraperitoneal section, with numerous openings and an open tip to allow dialysate to flow freely; (2) a subcutaneous section that passes from the peritoneal membrane and tunnels through muscle and subcutaneous fat to the skin; and (3) an external section for connection to the dialysate and tubing system. Most of these catheters have 2 cuffs made of Dacron polyester. The cuffs stabilize the catheter, limit movement,

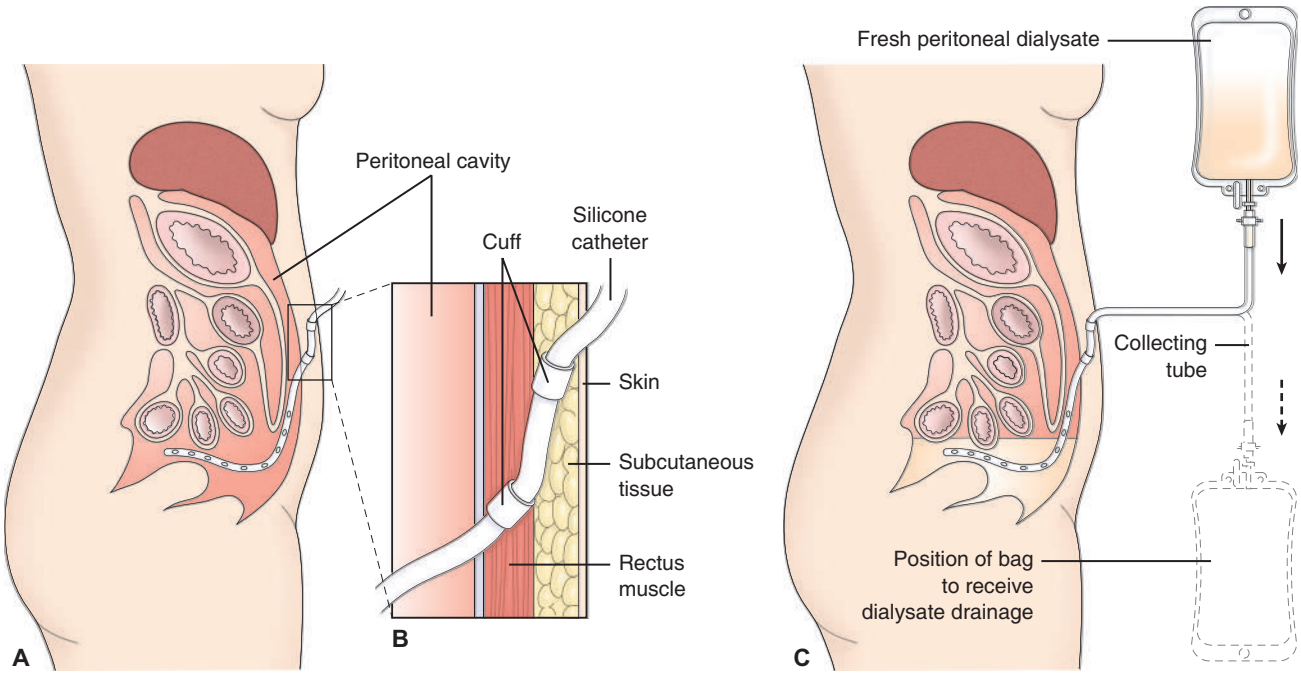


Figure 44-10 • Continuous ambulatory peritoneal dialysis. **A.** The peritoneal catheter is implanted through the abdominal wall. **B.** Dacron cuffs and a subcutaneous tunnel provide protection against bacterial infection. **C.** Dialysate flows by gravity through the peritoneal catheter into the peritoneal cavity. After a prescribed period of time, the fluid is drained by gravity and discarded. New solution is then infused into the peritoneal cavity until the next drainage period. Dialysis thus continues on a 24-hour-a-day basis, during which the patient is free to move around and engage in their usual activities.

prevent leaks, and provide a barrier against microorganisms. One cuff is placed just distal to the peritoneum, and the other cuff is placed subcutaneously. The subcutaneous tunnel (5 to 10 cm long) further protects against bacterial infection (see Fig. 44-10).

Performing the Exchange

PD involves a series of exchanges or cycles. An exchange is the entire cycle including the infusion (fill), dwell, and drainage of the dialysate. This cycle is repeated throughout the course of the dialysis. The dialysate is infused by gravity into the peritoneal cavity. A period of about 5 to 10 minutes is usually required to infuse 2 to 3 L of fluid. The prescribed dwell, or equilibration, time allows diffusion and osmosis to occur. At the end of the dwell time, the drainage portion of the exchange begins. The tube is unclamped, and the solution drains from the peritoneal cavity by gravity through a closed system. Drainage is usually completed in 10 to 20 minutes. The drainage fluid is normally colorless or straw colored and should not be cloudy. Bloody drainage may be seen in the first few exchanges after insertion of a new catheter but should not occur after that time. The number of cycles or exchanges and their frequency are prescribed based on monthly laboratory values and the presence of uremic symptoms. The exchanges can be performed manually during the waking hours by the patient (continuous ambulatory peritoneal dialysis [CAPD]) or via the use of a PD machine (cycler) that automatically performs exchanges, usually while the patient is sleeping at night (continuous cycling peritoneal dialysis [CCPD]).

The removal of excess water during PD occurs because dialysate has a high dextrose concentration, making it hypertonic. An osmotic gradient is created between the blood and the dialysate solution. Dextrose solutions of 1.5%, 2.5%, and 4.25% are available in several volumes, from 1000 to 3000 mL. The higher the dextrose concentration, the greater the osmotic gradient and the more water will be removed. Selection of the appropriate solution is based on the patient's fluid status.

Complications

Most complications of PD are often minor; however, several, if unattended, can have serious consequences.

Acute Complications

Peritonitis

Peritonitis is the most common and serious complication of PD. The first sign of peritonitis is cloudy dialysate drainage fluid. Diffuse abdominal pain and rebound tenderness occur much later. Hypotension and other signs of shock may also occur with advancing infection. The patient with peritonitis may be treated as an inpatient or outpatient (most common), depending on the severity of the infection and the patient's clinical status. Drainage fluid is examined for cell count; Gram stain and culture are used to identify the organism and guide treatment. Antibiotic agents (aminoglycosides or cephalosporins) are usually added to subsequent exchanges until Gram stain or culture results are available for appropriate antibiotic determination. Intraperitoneal administration of antibiotic agents is as effective as IV administration and therefore most often used. Antibiotic therapy continues for 10 to 14 days (Figueiredo, 2014). Careful selection and calculation of the antibiotic dosage are needed to prevent nephrotoxicity and further compromise of residual renal function.

Regardless of the organism causing peritonitis, the patient loses large amounts of protein through the peritoneum. Acute malnutrition and delayed healing may result. Therefore, attention must be given to detecting and promptly treating peritonitis.

Leakage

Leakage of dialysate through the catheter site may occur immediately after the catheter is inserted. Usually, the leak stops spontaneously if dialysis is withheld for several days, giving the

tissue surrounding the cuffs located on the abdominal catheter a chance to infiltrate the Dacron and seal the insertion tunnel. It also allows the exit site time to heal. During this time, it is important to reduce factors that might delay healing, such as undue abdominal muscle activity and straining during bowel movement. In many cases, leakage can be avoided by using small volumes (500 mL) of dialysate, gradually increasing the volume up to 2000 to 3000 mL.

Bleeding

A bloody effluent (drainage) may be observed occasionally, especially in young, menstruating women. (The hypertonic fluid pulls blood from the uterus, through the opening in the fallopian tubes, and into the peritoneal cavity.) Bleeding is also common during the first few exchanges after a new catheter insertion because some blood enters the abdominal cavity following insertion. In many cases, no cause can be found for the bleeding, although catheter displacement from the pelvis has occasionally been associated with bleeding. Some patients have had bloody effluent after an enema or from minor trauma. Most often, bleeding stops in 1 to 2 days and requires no specific intervention. More frequent exchanges and the addition of heparin to the dialysate during this time may be necessary to prevent blood clots from obstructing the catheter.

Long-Term Complications

Hypertriglyceridemia is common in patients undergoing long-term PD, suggesting that the therapy may accelerate atherogenesis. Cardiovascular disease is the leading cause of morbidity and mortality in patients with kidney failure, and many patients have suboptimal blood pressure control. Beta-blockers and ACE inhibitors should be used to control hypertension or protect the heart, and the use of aspirin and statins should be considered (James, Oparil, Carter, et al., 2014).

Other complications that may occur with long-term PD include abdominal hernias (incisional, inguinal, diaphragmatic, and umbilical), probably resulting from continuously increased intra-abdominal pressure. The persistently elevated intra-abdominal pressure also aggravates symptoms of hiatal hernia and hemorrhoids. Low back pain and anorexia from fluid in the abdomen and a constant sweet taste related to glucose absorption may also occur.

Mechanical problems occasionally occur and may interfere with instillation or drainage of the dialysate. Formation of clots in the peritoneal catheter and constipation are factors that may contribute to these problems.

Approaches

PD can be performed using several different approaches: acute intermittent peritoneal dialysis, CAPD, and CCPD.

Acute Intermittent Peritoneal Dialysis

Indications for acute intermittent PD, a variation of PD, include uremic signs and symptoms (nausea, vomiting, fatigue, altered mental status), fluid overload, acidosis, and hyperkalemia. Although PD is not as efficient as hemodialysis in removing solute and fluid, it permits a more gradual change in the patient's fluid volume status and in waste product removal. Therefore, it may be the treatment of choice for the hemodynamically unstable patient. It can be carried out manually (the nurse warms, spikes, and hangs each container of dialysate) or by a cycler machine. Exchange times range from 30 minutes to 2 hours. One routine is hourly exchanges consisting of a 10-minute infusion, a 30-minute dwell time, and a 20-minute drain time (Figueiredo, 2014).

Maintaining the PD cycle is a nursing responsibility. Aseptic technique is maintained when changing solution containers and emptying drainage containers. Vital signs, weight, I&O, laboratory values, and patient status are frequently monitored. The nurse uses a flow sheet or the electronic medical record to document each exchange and records vital signs, dialysate concentration, medications added, exchange volume, dwell time, dialysate fluid balance for each exchange (fluid lost or gained), and cumulative fluid balance. The nurse also carefully assesses skin turgor and mucous membranes to evaluate fluid status and monitor the patient for edema.

Nursing Alert: If the peritoneal fluid does not drain properly, the nurse can facilitate drainage by turning the patient from side to side or raising the head of the bed. The catheter should never be pushed further into the peritoneal cavity.

Other measures to promote drainage include checking the patency of the catheter by inspecting for kinks, closed clamps, or an air lock. The nurse monitors for complications, including peritonitis, bleeding, respiratory difficulty, and leakage of peritoneal fluid. Abdominal girth may be measured periodically to determine if the patient is retaining large amounts of dialysis solution. In addition, the nurse must ensure that the PD catheter remains secure and that the dressing remains dry. Physical comfort measures, frequent turning, and skin care are provided. The patient and family are educated about the procedure and are kept informed about progress (fluid loss, weight loss, laboratory values). Emotional support and encouragement are given to the patient and family during this stressful and uncertain time.

Continuous Ambulatory Peritoneal Dialysis

Continuous Ambulatory Peritoneal Dialysis (CAPD) is the second most common form of dialysis for patients with ESKD (USRDS, 2015). CAPD is performed at home by the patient or a trained caregiver who is usually a family member. The procedure allows the patient reasonable freedom and control of daily activities but requires a serious commitment to be successful. Chart 44-10 discusses suitability for CAPD.

CAPD works on the same principles as other forms of PD: diffusion and osmosis. Less extreme fluctuations in the patient's laboratory values occur with CAPD than with intermittent PD or hemodialysis because the dialysis is constantly in progress. The serum electrolyte levels usually remain in the normal range.

Procedure

The patient performs exchanges 4 or 5 times a day, 24 hours a day, 7 days a week, at intervals scheduled throughout the day. Different manufacturers supply different equipment. A Y-shaped system is most commonly used, in which a bag containing dialysate solution comes connected to one branch of the "Y" and a sterile empty bag is connected to the second branch. This leaves the third part of the "Y" open and available for connection to the transfer set on the PD catheter. To perform an exchange, the patient (or person doing the exchange) washes their hands, dons a mask, and then removes the cap from the transfer set while maintaining sterility. The open end of the "Y" set is connected to the end of the transfer set and the dialysate infused where it will dwell. After the dialysate is infused, the patient clamps off the transfer set and the tubing set, disconnects the tubing set, and applies a new cap to the transfer set, making

Chart 44-10

Considerations in Continuous Ambulatory Peritoneal Dialysis

Although continuous ambulatory peritoneal dialysis (CAPD) is not suitable for all patients with end-stage kidney disease (ESKD), it is a viable therapy for those who can perform self-care and fluid exchanges and fit therapy into their own routines. Often, patients report having more energy and feeling healthier once they begin CAPD. Nurses can be instrumental in helping patients with ESKD find the dialysis therapy that best suits their lifestyle. Those considering CAPD need to understand the advantages and disadvantages along with the indications and contraindications for this form of therapy.

Advantages

- Freedom from a hemodialysis machine
- Control over daily activities
- Opportunities to eat a more liberal diet than allowed with hemodialysis, increase fluid intake, raise serum hematocrit values, improve blood pressure control, avoid venipuncture, and gain a sense of well-being

Disadvantages

- Continuous dialysis 24 hours a day, 7 days a week
- Dietary alterations related to protein and potassium losses. Patients may be encouraged to increase the intake of protein and potassium in the diet due to these losses with peritoneal dialysis fluid exchanges

Indications

- Patient's willingness, motivation, and ability to perform dialysis at home
- Strong family or community support system (essential for success), particularly if the patient is an older adult
- Special problems with long-term hemodialysis, such as dysfunctional or failing vascular access devices, excessive thirst, severe hypertension, postdialysis headaches, and severe anemia requiring frequent transfusion
- Interim therapy while awaiting kidney transplantation
- ESKD secondary to diabetes because hypertension, uremia, and hyperglycemia are easier to manage with CAPD than with hemodialysis

Contraindications

- Adhesions from previous surgery (adhesions reduce clearance of solutes) or systemic inflammatory disease
- Chronic backache and pre-existing disc disease, which could be aggravated by the continuous pressure of dialysis fluid in the abdomen
- Severe arthritis or poor hand strength necessitating assistance in performing the exchange. However, patients who are blind or partially blind and those with other physical limitations can learn to perform CAPD

it a closed system. The patient drains the fluid (effluent) from the peritoneal cavity through the catheter (over about 20 to 30 minutes) into an empty bag. Once the effluent has been fully drained, fresh fluid is instilled into the peritoneal cavity.

The longer the dwell time, the better the clearance of uremic toxins. If dwell time is excessive, the patient will absorb some of the effluent back into the body simply because the osmotic gradient is lost. Once equilibrium is reached, the movement of fluid and toxins stops.

Complications

To reduce the risk of peritonitis, the patient (and all caregivers) must use meticulous care to avoid contaminating the catheter, fluid, or tubing and to avoid accidentally disconnecting the catheter from the tubing. Whenever a connection or disconnection is made, hand hygiene must be used and a mask worn by anyone within 6 ft of the area to avoid contamination with airborne bacteria. Excess manipulation should be avoided, and meticulous care of the catheter entry site is provided using a standardized protocol.

Continuous Cyclic Peritoneal Dialysis

Continuous cyclic peritoneal dialysis (CCPD) uses a machine called a cycler to provide the fluid exchanges. It is programmed to deliver an established amount of PD solution that will dwell in the peritoneal cavity for a programmed period of time before it drains from the peritoneal cavity via gravity. The cycler is also set to deliver a specific number of fluid changes in a designated period of time. Because it is programmed, it also keeps track of the total amounts removed and will sound an alarm if limits are not met. It requires that a person set up and break down the system for use, which typically takes about 15 minutes.

CCPD combines overnight intermittent PD with a prolonged dwell time during the day. The peritoneal catheter is connected to a cycler machine every evening, usually just before the patient goes to sleep for the night. Because the machine is very quiet, the patient can sleep, and the extra-long tubing allows the patient to move and turn normally during sleep.

In the morning, the patient disconnects from the cycler. Sometimes, dialysate is left in the abdominal cavity for a longer day dwell cycle. This day exchange is drained during the day either by using a "Y" set or reattaching to the cycler. This process is done every day to achieve the effects of dialysis required.

CCPD has a lower infection rate than other forms of PD because there are fewer opportunities for contamination with bag changes and tubing disconnections (Hain & Chan, 2013). It also allows the patient to be free from exchanges throughout the day, making it possible to engage in work and activities of daily living more freely.

Nursing Management

Meeting Psychosocial Needs

In addition to the complications of PD described previously, patients who elect to do PD may experience altered body image because of the presence of the abdominal catheter, bag, tubing, and cycler. Waist size increases from 1 to 2 inches (or more) with fluid in the abdomen. This affects clothing selection and may make the patient feel "fat." Body image may be threatened if patients do not want to look at or care for the catheter. The nurse may arrange for the patient to talk with other patients who have adapted well to PD. Although some patients have no psychological problems with the catheter—they think of it as their lifeline and as a life-sustaining device—other patients feel they are doing exchanges all day long and have no free time, particularly in the beginning. They may experience depression because they feel crushed with the responsibility of self-care.

Patients undergoing PD may also experience altered sexuality patterns and sexual dysfunction. The patient and partner may be reluctant to engage in sexual activities, partly

because of the catheter being psychologically "in the way" of sexual performance. The peritoneal catheter, drainage bag, and about 2 L of dialysate may interfere with the patient's sexual function and body image as well. In patients on CCPD, the presence of the dialysis cycler in the bedroom and the continual connection during the sleeping hours can also cause interference with intimacy. Although these problems may resolve with time, some problems may warrant special counseling. Questions by the nurse about concerns related to sexuality and sexual function often provide the patient with a welcome opportunity to discuss these issues and a first step toward their resolution.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

Patients are educated as inpatients or outpatients to perform PD once their condition is medically stable. Education usually takes 5 days to 2 weeks. Patients are taught according to their own learning ability and knowledge level and only as much at one time as they can handle without feeling uncomfortable or becoming saturated. Education topics for the patient and family who will be performing PD at home are described in Chart 44-11. The use of an adult learning theory–based curriculum may decrease peritonitis and exit site infection rates (Hain & Chan, 2013).

Because of protein loss with continuous PD, the patient is instructed to eat a high-protein, nutritious diet. The patient is also encouraged to increase their daily fiber intake to help prevent constipation, which can impede the flow of dialysate into or out of the peritoneal cavity. Many patients gain 1 to 2 Kg within a month of initiating PD, so they may be asked to limit their carbohydrate intake to avoid excessive weight gain. Potassium, sodium, and fluid restrictions are not usually needed. Patients commonly lose about 2 to 3 L of fluid over and above the volume of dialysate infused into the abdomen during a 24-hour period, permitting a normal fluid intake even in a patient who is without functional kidneys.

Continuing and Transitional Care

Follow-up care through phone calls, visits to the dialysis clinic, outpatient department, and continuing home care assists patients in the transition to home and promotes their active participation in their own health care. Patients often check with the nurse to see if they are making the correct choices about dialysate or control of blood pressure, or simply to discuss a problem.

Patients may be seen by the PD team as outpatients once a month or more often if needed. The exchange procedure is evaluated at that time to see that strict aseptic technique is being used. Blood chemistry values are followed closely to make certain the therapy is adequate for the patient.

If a referral is made for home care, the home care nurse assesses the home environment and suggests modifications to accommodate the equipment and facilities needed to carry out PD. In addition, the nurse assesses the patient's and family's understanding of PD and evaluates their technique in performing PD. Assessments include checking for changes related to kidney disease; complications such as peritonitis; and treatment-related problems such as heart failure, inadequate drainage, and weight gain or loss. The nurse continues to reinforce and clarify education about PD and ESKD and assesses the patient's and family's progress in coping with the procedure. This is also an opportunity to remind patients about the need to participate in appropriate health promotion activities and health screening (e.g., gynecologic examinations, colonoscopy).

Chart 44-11 HOME CARE CHECKLIST

Peritoneal Dialysis, Continuous Ambulatory Peritoneal Dialysis, or Continuous Cycling Peritoneal Dialysis

At the completion of education, the patient and/or caregiver will be able to:

- Discuss kidney disease and its effects on the body.
- State the goal and purpose of dialysis and its impact on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- Describe the basic principles of peritoneal dialysis (PD) and exchange options such as continuous ambulatory peritoneal dialysis (CAPD), or continuous cycling peritoneal dialysis (CCPD).
- State what types of changes are needed (if any) to support home PD therapy and maintain a clean home environment and prevent infection.
- State how to contact the primary provider, the team of home care professionals overseeing care, and supply vendor.
  - Discuss ordering, storage, and inventory of dialysis supplies.
  - List emergency phone numbers.
- State the name, dose, side effects, frequency, and schedule for all medications.
  - Demonstrate procedure for adding medications to the dialysis solution.
- Demonstrate catheter and exit site care.
- Demonstrate measurement of vital signs and weight measurement.
- Discuss monitoring and management of fluid balance.
- Discuss basic principles of aseptic technique.
- Demonstrate the CAPD or CCPD exchange procedure using aseptic technique (patients receiving CCPD should also demonstrate exchange procedure in case of failure or unavailability of cycling machine) and discuss cycling machine warning signals and how to address these signals.
- Demonstrate maintenance of home dialysis records.
- Demonstrate procedure for obtaining sterile peritoneal dialysis fluid samples.
- Discuss routine laboratory tests needed and implications of results.
- Discuss high protein diet and diet to avoid constipation, any other dietary restrictions as indicated.
- Discuss complications of peritoneal dialysis; prevention, recognition, and management of complications.
- Describe actions in case of emergency.
- Relate how to reach primary provider with questions or complications.
- State time and date of follow-up medical appointments, therapy, and testing.
- Coordinate financial arrangements for peritoneal dialysis and strategies to identify and obtain resources.
- Identify sources of support (e.g., friends, relatives, faith community, support groups, caregiver support).
- Identify the need for health promotion, disease prevention, and screening activities.

ADL, activities of daily living; IADL, independent activities of daily living.

Special Considerations: Nursing Management of the Patient on Dialysis Who Is Hospitalized

Whether undergoing hemodialysis or PD, the patient may be hospitalized for treatment of complications related to the dialysis treatment, the underlying kidney disorder, or health problems not related to renal dysfunction or its treatment.

Protecting Vascular Access

When the patient undergoing hemodialysis is hospitalized for any reason, care must be taken to protect the vascular access. The nurse assesses the vascular access for patency and takes precautions to ensure that the extremity with the vascular access is not used for measuring blood pressure or for obtaining blood specimens; tight dressings, restraints, or jewelry over the vascular access must be avoided as well (Arslanian, 2015).

The bruit, or "thrill," over the venous access site must be evaluated at least every shift. Absence of a palpable thrill or audible bruit may indicate blockage or clotting in the vascular access. Clotting can occur if the patient has an infection anywhere in the body (serum viscosity increases) or if the blood pressure has dropped. When blood flow is reduced through the access for any reason (hypotension, application of blood pressure cuff or tourniquet), the access can clot. If a patient has a hemodialysis catheter or implanted hemodialysis access device, the nurse must observe for signs and symptoms of infection such as redness, swelling, drainage from the exit site, fever, and chills. The nurse must assess the integrity of the dressing and change it as needed. Patients with kidney disease are more prone to infection; therefore, appropriate infection control measures must be used for all procedures. The patient's vascular access device should not be used for any purpose other than dialysis, unless it is an emergency situation and no other access is available. In this situation, a dialysis nurse or physician should cannulate the vascular access.

Taking Precautions During Intravenous Therapy

When the patient needs IV therapy, the rate of administration must be as slow as possible. Accurate I&O records are essential.

Nursing Alert: Because patients on dialysis cannot excrete water, rapid administration of IV fluid can result in pulmonary edema.

Monitoring Symptoms of Uremia

As metabolic end products accumulate, symptoms of uremia worsen. Patients whose metabolic rate accelerates (those receiving corticosteroid medications or parenteral nutrition, those with infections or bleeding disorders, those undergoing surgery) accumulate waste products more quickly and may require daily dialysis. These same patients are more likely than other patients receiving dialysis to experience complications.

Detecting Cardiac and Respiratory Complications

Cardiac and respiratory assessment must be conducted frequently. As fluid builds up, fluid overload, heart failure, and pulmonary edema develop. Crackles in the bases of the lungs may indicate pulmonary edema.

Pericarditis may result from the accumulation of uremic toxins. If not detected and treated promptly, this serious complication may progress to pericardial effusion and cardiac tamponade. Pericarditis is detected by the patient's report of substernal chest pain (if the patient can communicate), low-grade fever, and pericardial friction rub. A pulsus paradoxus (a decrease in blood pressure of more than 10 mm Hg during inspiration) is often present. When pericarditis progresses to effusion, the friction rub disappears, heart sounds become distant and muffled, ECG waves show very low voltage, and the pulsus paradoxus worsens (Yamamoto, Shoji, Yamakawa, et al., 2015).

The effusion may progress to life-threatening cardiac tamponade, noted by narrowing of the pulse pressure in addition to muffled or inaudible heart sounds, crushing chest pain, dyspnea, and hypotension.

Nursing Alert: Although pericarditis, pericardial effusion, and cardiac tamponade can be detected by chest x-ray, they should also be detected through astute nursing assessment. Because of their clinical significance, assessment of the patient for these complications is a priority.

Controlling Electrolyte Levels and Diet

Electrolyte alterations are common, and potassium changes can be life threatening. All IV solutions and medications to be given are evaluated for their electrolyte content. Serum laboratory values are assessed daily. If blood transfusions are required, they may be given during hemodialysis, if possible, so that excess potassium can be removed and hypervolemia is avoided. Dietary intake must also be monitored. The patient's frustrations related to dietary restrictions typically increase if the food is unappetizing. The nurse needs to recognize that this may lead to dietary indiscretion and hyperkalemia.

Hypoalbuminemia is an indicator of malnutrition in patients undergoing long-term or maintenance dialysis. Although some patients can be treated with adequate nutrition alone, some patients remain hypoalbuminemic for reasons that are poorly understood.

Managing Discomfort and Pain

Complications such as pruritus and pain secondary to neuropathy must be managed. Antihistamine agents, such as diphenhydramine (Benadryl), are commonly used, and analgesic medications may be prescribed. However, because elimination of the metabolites of medications occurs through dialysis rather than through renal excretion, medication dosages may need to be adjusted. Keeping the skin clean and well moisturized using bath oils, superfatted soap, and creams or lotions helps promote comfort and reduce itching. Instructing the patient to keep the nails trimmed to avoid scratching and excoriation also promotes comfort.

Monitoring Blood Pressure

Hypertension in kidney disease is common. It is usually the result of fluid overload and, in part, oversecretion of renin. Many patients undergoing dialysis receive some form of antihypertensive therapy. Patients require detailed education and reinforcement of information regarding their antihypertensive regimen, because it is not uncommon for patients to need more than one antihypertensive agent. Rapid fluid fluctuations in patients receiving dialysis also create challenges to maintaining blood pressure control. Antihypertensive agents must be withheld before dialysis to avoid hypotension due to the combined effect of fluid removal with the dialysis treatment and the medication (Doss-McQuitty, 2014).

Typically, these patients require single or multiple antihypertensive agents to achieve normal blood pressure, thus adding to the total number of medications needed on an ongoing basis (James et al., 2014).

Preventing Infection

Patients with ESKD commonly have low WBC counts (and decreased phagocytic ability), low RBC counts (anemia), and impaired platelet function. Together, these pose a high risk of infection and potential for bleeding after even minor trauma. Preventing and controlling infection are essential because the incidence of infection is high. Infection of the vascular access site and pneumonia are common.

Caring for the Catheter Site

Patients receiving CAPD usually know how to care for the catheter site; however, the hospital stay is an opportunity to assess catheter care technique and correct misperceptions or deviations from recommended technique. Recommended daily or 3 or 4 times-weekly routine catheter site care is typically performed during showering or bathing (Hain & Chan, 2013). The exit site should not be submerged in bathwater. The most common cleaning method is soap and water; liquid soap is recommended. During care, the nurse and patient need to make sure that the catheter remains secure to avoid tension and trauma. The patient may wear a gauze or semitransparent dressing over the exit site.

Administering Medications

All medications and the dosage prescribed for any patient on dialysis must be closely monitored to avoid those that are toxic to the kidneys and may threaten remaining renal function. Medications are also scrutinized for potassium and magnesium content; those medications that contain them are avoided. Care must be taken to evaluate all problems and symptoms that the patient reports without automatically attributing them to kidney disease or to dialysis therapy.

Providing Psychological Support

Patients undergoing dialysis for a while may begin to reevaluate their status, the treatment modality, their satisfaction with life, and the impact of these factors on their families and support systems. Nurses must provide opportunities for these patients to express their feelings and reactions and to explore options. The decision to begin dialysis does not require that dialysis be continued indefinitely, and it is not uncommon for patients to consider discontinuing treatment. These feelings and reactions must be taken seriously, and the patient should have the opportunity to discuss them with the dialysis team as well as with a psychologist, psychiatrist, psychiatric nurse, trusted friend, or spiritual advisor. The patient's informed decision about discontinuing treatment, after thoughtful deliberation, should be respected.

KIDNEY SURGERY

A patient may undergo surgery to remove obstructions that affect the kidney (tumors or calculi), to insert a tube for draining the kidney (nephrostomy, ureterostomy), or to remove the kidney involved in unilateral kidney disease, renal carcinoma, or kidney transplantation.

Management of Patients Undergoing Kidney Surgery

Preoperative Considerations

Surgery is performed only after a thorough evaluation of renal function. Patient preparation to ensure that optimal renal function is maintained is essential. Fluids are encouraged to promote increased excretion of waste products before surgery unless contraindicated because of pre-existing renal or cardiac dysfunction. If kidney infection is present preoperatively, broad-spectrum antimicrobial agents may be prescribed to prevent bacteremia. Antibiotic agents must be given with extreme care because many are toxic to the kidneys. Coagulation studies (prothrombin time, partial thromboplastin time, platelet count) may be indicated if the patient has a history of bruising and bleeding. The preoperative preparation is similar to that described in Chapter 4.

Because many patients facing kidney surgery are apprehensive, the nurse encourages the patient to recognize and verbalize concerns. Confidence is reinforced by establishing a relationship of trust and by providing expert care. Patients faced with the prospect of losing a kidney may think that they will have to depend on dialysis for the rest of their lives. The nurse reassures the patient and family that normal function may be maintained by a single healthy kidney.

Perioperative Concerns

Kidney surgery requires various patient positions to expose the surgical site adequately. Three surgical approaches are common: flank, lumbar, and thoracoabdominal (see Fig. 44-11). During surgery, plans are carried out for managing altered urinary drainage. These may include inserting a nephrostomy or other drainage tube.

Postoperative Management

Because the kidney is a highly vascular organ, hemorrhage and shock are the chief potential complications of kidney surgery. Fluid and blood component replacement is frequently necessary in the immediate postoperative period to treat intraoperative blood loss.

Abdominal distention and paralytic ileus are fairly common after renal and ureteral surgery and are thought to be due to a reflex paralysis of intestinal peristalsis and manipulation of the colon or duodenum during surgery. Abdominal distention is relieved by decompression through a nasogastric tube. See Chapter 18 for treatment of paralytic ileus. Oral fluids are permitted when the passage of flatus is noted.

If infection occurs, antibiotics are prescribed after a culture reveals the causative organism. The toxic effects that antibiotic agents have on the kidneys (nephrotoxicity) must be kept in mind when assessing the patient. Low-dose heparin therapy may be initiated postoperatively to prevent thromboembolism in patients who have had any type of urologic surgery.

Nursing Management

In addition to those interventions listed in this section, Chart 44-12 provides a plan of nursing care for the patient undergoing kidney surgery.

Providing Immediate Postoperative Care

Immediate postoperative care of the patient who has undergone surgery of the kidney includes assessment of all body systems.

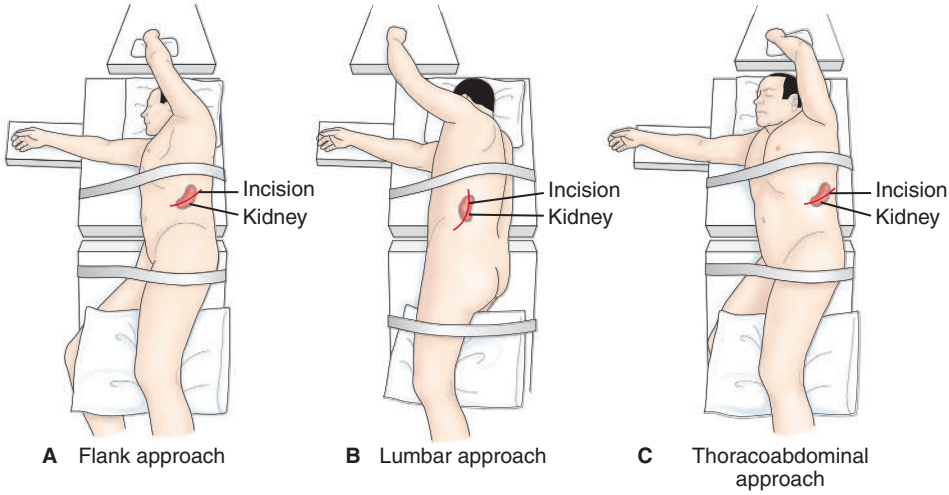


Figure 44-11 • Patient positioning and incisional approaches—flank (**A**), lumbar (**B**), thoracoabdominal (**C**)—for kidney surgery are associated with significant postoperative discomfort.

Chart 44-12 PLAN OF NURSING CARE

Care of the Patient Undergoing Kidney Surgery

NURSING DIAGNOSIS: Ineffective airway clearance related to pain of high abdominal or flank incision, abdominal discomfort, and immobility; risk for ineffective breathing pattern related to high abdominal incision
GOAL: Improved airway clearance

Nursing Interventions	Rationale	Expected Outcomes
1. Assess respiratory status: a. Rate b. Breath sounds	1. Baseline data allow for monitoring of changes and evaluating effectiveness of interventions.	• Exhibits respiratory rate of 12–18 breaths/min and normal breath sounds without adventitious sounds
2. Administer analgesic agent as prescribed.	2. Adequate pain relief enables patient to take deep breaths and cough.	• Takes deep breaths and coughs adequately when encouraged and assisted sounds
3. Splint incision with hands or pillow to assist patient in coughing.	3. Splinting the incision promotes adequate cough thereby prevents atelectasis.	• Exhibits full thoracic excursion without shallow respirations
4. Assist patient to change positions frequently.	4. Promotes drainage and inflation of all lobes of the lungs.	• Uses incentive spirometer with encouragement
5. Encourage the use of incentive spirometer if indicated or prescribed.	5. Encourages adequate deep breaths.	• Splints incision while taking deep breaths and coughing
6. Assist with and encourage early ambulation.	6. Mobilizes pulmonary secretions.	• Reports progressively less pain and discomfort with coughing and deep breaths

NURSING DIAGNOSIS: Acute pain and discomfort related to surgical incision, positioning, and stretching of muscles during kidney surgery
GOAL: Relief of pain and discomfort

Nursing Interventions	Rationale	Expected Outcomes
1. Assess level of pain.	1. Provides baseline for later evaluation of pain relief strategies.	• Reports relief of severe pain and discomfort • Takes analgesia as prescribed
2. Administer analgesic agents as prescribed.	2. Promotes pain relief.	• Exercises aching muscles within recommendations
3. Splint incision with hands or pillow during movement or deep breathing and coughing exercises.	3. Minimizes sensation of pulling or tension on incision and provides sense of support to the patient.	• Uses distraction, relaxation exercises, and imagery to relieve pain
4. Assist and encourage early ambulation.	4. Promotes resumption of muscle activity exercise.	• Exhibits no behavioral manifestations of pain and discomfort (e.g., restlessness, perspiration, verbal expressions of pain)
5. Offer and educate patient how to use appropriate nonpharmacologic interventions.	5. Many nonpharmacologic interventions, such as distraction, relaxation exercises, and imagery assist patients to decrease their pain.	• Participates in deep-breathing and coughing exercises • Gradually increases physical activity and exercise

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NURSING DIAGNOSIS: Fear and anxiety related to diagnosis, outcome of surgery, and alteration in urinary function
GOAL: Reduction of fear and anxiety

Nursing Interventions	Rationale	Expected Outcomes
1. Assess patient's anxiety and fear before surgery if possible.	1. Provides a baseline for postoperative assessment.	• Verbalizes reactions and feelings to staff • Shares reactions and feelings with family or partner • Grieves appropriately for self and for changes in role and function • Identifies information needed to promote own adaptation and coping • Participates in activities and events in immediate environment • Accepts visit from support group if indicated • Identifies support person or support group
2. Assess patient's knowledge about procedure and expected surgical outcome preoperatively.	2. Provides a basis for further education.	
3. Evaluate the meaning of alterations resulting from surgical procedure for the patient and family or partner.	3. Enables understanding of patient's reactions and responses to expected and unexpected results of surgery.	
4. Encourage patient to verbalize reactions, feelings, and fears.	4. Affirms patient's understanding of and ultimate resolution of feelings and fears.	
5. Encourage patient to share feelings with spouse or partner.	5. Enables patient and partner to receive mutual support and reduces sense of isolation from each other.	
6. Offer and arrange for visit from member of support group (e.g., ostomy group, transplant group, if indicated).	6. Provides support from another person who has encountered the same or a similar surgical procedure and an example of how others have coped with the alteration.	

NURSING DIAGNOSIS: Impaired urinary elimination related to urinary drainage; risk for infection related to altered urinary drainage
GOAL: Maintenance of urinary elimination; infection-free urinary tract

Nursing Interventions	Rationale	Expected Outcomes
1. Assess urinary drainage system immediately.	1. Provides basis for further assessment and action.	• Exhibits adequate urinary output and patent drainage system • Exhibits urinary output consistent with fluid intake • Demonstrates normal laboratory values: blood urea nitrogen, serum creatinine levels, urine specific gravity, and osmolality • Exhibits sterile urine on urine culture • Exhibits clear, dilute urine without debris or encrustation in the drainage system • States rationale for avoiding manipulation of catheter, drainage, or irrigation system • Exhibits normal placement of urinary stent or ureteral catheters until removed by physician • Maintains closed urinary drainage system • Exhibits normal body temperature without signs or symptoms of urinary tract infection • Cleans catheter with soap and water • Consumes adequate fluid intake (6–8 glasses of water or more per day, unless contraindicated) • Urinary drainage system remains in place until physician removes or discontinues it • Maintains urinary drainage system without infection or obstruction • Maintains urinary diversion as instructed • Maintains self-care so that environment is odor free
2. Assess adequacy of urinary output and patency of drainage system.	2. Provides baseline.	
3. Assess pertinent laboratory values (see Table 43-5).	3. Provides basis for further assessment and action.	
4. Use asepsis and hand hygiene when providing care and manipulating drainage system.	4. Prevents or reduces risk of contamination of urinary drainage system.	
5. Maintain closed urinary drainage system.	5. Reduces risk of bacterial contamination and infection.	
6. If irrigation of the drainage system is necessary, use sterile gloves and sterile irrigating solution and a closed drainage and irrigation system.	6. Permits irrigation when necessary while maintaining closed drainage system, minimizing risk of infection.	
7. If irrigation is necessary and prescribed, perform it gently with sterile saline and the prescribed amount of irrigating fluid.	7. Maintains patency of the catheter or drainage system and prevents sudden increases in pressure in the urinary tract that may cause trauma, pressure on sutures or urinary tract structures, and pain.	
8. Assist patient in turning and moving in bed and when ambulating to prevent displacement or inadvertent removal of urinary stent or ureteral catheters if in place.	8. Prevents trauma from accidental displacement of urinary stent or ureteral catheter necessitating repeated instrumentation of the urinary tract (e.g., cystoscopy) to replace them.	
9. Observe urine color, volume, odor, and components.	9. Provides information about adequacy of urine output, condition and patency of drainage system, and debris in urine.	
10. Minimize trauma and manipulation of catheter, drainage system, and urethra.	10. Reduces risk of contamination of drainage system and eliminates site of bacterial invasion.	
11. Clean catheter gently with soap during bathing, avoiding any to-and-fro movement of catheter.	11. Removes debris and encrustations without causing trauma to or contamination of urethra.	

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12. Anchor drainage tube.	12. Prevents movement or slipping of drainage tube, minimizing trauma to and contamination of urethra or catheter.
13. Maintain adequate fluid intake.	13. Promotes adequate urine output and prevents urinary stasis.
14. Assist with and encourage early ambulation while ensuring placement of urinary drainage system.	14. Minimizes cardiovascular and pulmonary complications while preventing loss, dislodging, or disruption of drainage system.
15. If patient is to be discharged with urinary drainage system (catheter) in place or a urinary diversion, instruct patient and family member in care.	15. Knowledge and understanding of the drainage system or urinary diversion are essential to prevent infection and other complications.

NURSING DIAGNOSIS: Risk for imbalanced fluid volume related to surgical fluid loss, altered urinary output, parenteral fluid administration
GOAL: Normal fluid balance will be maintained

Nursing Interventions	Rationale	Expected Outcomes
1. Weigh patient daily.	1. Daily weight is the most sensitive indicator of fluid loss or gain.	• Patient's weight will be within 1–1.25 Kg of patient's baseline.
2. Take accurate intake and output measurements.	2. Detects fluid retention due to poor cardiac or renal output.	• Intake that exceeds output will be detected early.
3. Place all parenteral therapy on an infusion pump.	3. Ensures that the patient does not receive excess or insufficient IV fluids.	
4. Monitor amount and characteristics of urine.	4. Assists in early detection of possible complications of surgery or tube insertion.	• The exact amount of solution is infused with no adverse effects resulting from over- or underinfusion.
5. Monitor vital signs: temperature, pulse, respirations, and blood pressure.	5. When fluid volume or cardiac output is altered, vital signs are affected.	• Urine is clear and absent of blood, pus, or any foreign substances.
6. Auscultate heart and lungs every shift.	6. When fluid volume is increased because of poor cardiac or renal output, fluid accumulates in the lungs. In addition, heart sounds change as heart failure develops; frequent auscultation ensures early detection.	• Temperature, pulse, respiration, and blood pressure are normal. • Normal heart and lung sounds are present.

Respiratory and circulatory status, pain level, fluid and electrolyte status, and patency and adequacy of urinary drainage systems are assessed.

Respiratory Status

As with any surgery, the use of anesthesia increases the risk of respiratory complications. Noting the location of the surgical incision assists the nurse in anticipating respiratory problems and pain. Respiratory status is assessed by monitoring the rate, depth, and pattern of respirations. The location of the incision frequently causes pain on inspiration and coughing; therefore, the patient tends to splint the chest wall and take shallow respirations. Auscultation is performed to assess normal and adventitious breath sounds.

Circulatory Status and Blood Loss

The patient's vital signs and arterial or central venous pressure are monitored. Skin color and temperature and urine output provide information about circulatory status. The surgical incision and drainage tubes are observed frequently to help detect unexpected blood loss and hemorrhage.

Pain

Postoperative pain is a major problem for the patient because of the location of the surgical incision and patient's position on the operating table to permit access to the kidney. The location and severity of pain are assessed before and after analgesic medications are given. Abdominal distention, which increases discomfort, is also noted.

Urinary Drainage

Urine output and drainage from tubes inserted during surgery are monitored for amount, color, and type or characteristics. Decreased or absent drainage is promptly reported to the primary provider because it may indicate obstruction that could cause pain, infection, and disruption of the suture lines.

Monitoring and Managing Potential Complications

Bleeding is a major complication of kidney surgery. If undetected and untreated, it can result in hypovolemia and hemorrhagic shock. The nurse's role is to observe for these complications, to report their signs and symptoms, and to administer prescribed parenteral fluids and blood and blood components. Monitoring of vital signs, skin condition, the urinary drainage system, the surgical incision, and the level of consciousness is necessary to detect evidence of bleeding, decreased circulating blood, and fluid volume and cardiac output. Frequent monitoring of vital signs (initially monitored at least at hourly intervals) and urinary output is necessary for early detection of these complications.

If bleeding goes undetected or is not detected promptly, the patient may lose significant amounts of blood and may experience hypoxemia. In addition to hypovolemic shock due to hemorrhage, this type of blood loss may precipitate a myocardial infarction or transient ischemic attack. Bleeding may be suspected when the patient experiences fatigue and when urine output is less than 0.5 mL/kg/hr. As bleeding persists, late signs of hypovolemia occur, such as cool skin, flat neck veins, and change in level of consciousness or responsiveness. Transfusions of blood components are indicated, along with surgical repair of the bleeding vessel.

Pneumonia may be prevented through the use of an incentive spirometer, adequate pain control, and early ambulation. Early signs of pneumonia include fever, increased heart and respiratory rates, and adventitious breath sounds.

Preventing infection involves using asepsis when changing dressings and handling and preparing catheters, other drainage tubes, central venous catheters, and IV catheters for administration of fluids. Insertion sites are monitored closely for signs and symptoms of inflammation: redness, drainage, heat, and pain. Special care must be taken to prevent UTI, which is associated with the use of indwelling urinary catheters. Catheters and other invasive tubes are removed as soon as they are no longer needed.

Antibiotics are commonly given postoperatively to prevent infection. If antibiotic agents are prescribed, serum creatinine and BUN values must be monitored closely because many antibiotic agents are toxic to the kidney or can accumulate to toxic levels if renal function is decreased.

Preventing fluid imbalance is critical when caring for a patient undergoing kidney surgery, because both fluid loss and fluid excess are possible adverse effects of the surgery. Fluid loss may occur during surgery as a result of excessive urinary drainage when the obstruction is removed, or it may occur if diuretic agents are used. Such loss may also occur with GI losses, in the form of diarrhea resulting from antibiotic use, or excessive nasogastric drainage. When postoperative IV therapy is inadequate to match the output or fluids lost, a fluid deficit results. Fluid excess, or overload, may result from cardiac effects of anesthesia, administration of excessive amounts of fluids, or the patient's inability to excrete fluid because of changes in renal function. Decreased urine output may be an indication of fluid excess.

Astute assessment skills are needed to detect early signs of fluid excess (such as weight gain, pedal edema, urine output below 0.5 mL/kg/hr, and slightly elevated pulmonary artery wedge pressure if available) before they become severe (appearance of adventitious breath sounds, shortness of breath).

Fluid excess may be treated with fluid restriction and administration of furosemide (Lasix) or other diuretic agents. If renal insufficiency is present, these medications may prove ineffective; therefore, dialysis may be necessary to prevent heart failure and pulmonary edema.

Deep vein thrombosis (DVT) may occur postoperatively because of surgical manipulation of the iliac vessels during surgery or prolonged immobility. Antiembolism stockings are applied, and the patient is monitored closely for signs and symptoms of thrombosis and encouraged to exercise the legs. Heparin may be given postoperatively to reduce the risk of thrombosis.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

If the patient has a drainage system in place, measures are taken to ensure that both the patient and family understand the importance of maintaining the system correctly at home and preventing infection. Verbal and written instructions and guidelines are provided to the patient and family at the time of hospital discharge. The patient may be asked to demonstrate management of the drainage system to ensure understanding. The importance of strategies to prevent postoperative complications (urinary tract obstruction and infection, DVT, atelectasis, and pneumonia) is stressed to the patient and family. The nurse reviews the signs, symptoms, problems, and questions that should be referred to the physician or other primary provider with the patient and family.

Continuing and Transitional Care

The need for postoperative assessment and care after kidney surgery continues regardless of the setting: the home, subacute care unit, outpatient clinic or office, or rehabilitation facility. Referral for home care is indicated for the patient going home with a urinary drainage system in place. During the home visit, the home care nurse reviews the instructions and guidelines given to the patient at hospital discharge. The nurse assesses the patient's ability to carry out the instructions in the home and answers questions that the patient or family has about management of the drainage system and the surgical incision.

In addition, the home care nurse obtains vital signs and assesses the patient for signs and symptoms of urinary tract obstruction and infection. The nurse also ensures that pain is adequately controlled and that the patient is complying with recommendations. The home care nurse encourages adequate fluid intake and increased levels of activity. Together, the nurse, patient, and family review the signs, symptoms, problems, and questions that should be referred to the primary provider. If the patient has a drainage tube in place, the nurse assesses the site and the patency of the system and monitors the patient for complications, such as DVT, bleeding, or pneumonia.

Because it is easy for the patient, family, and health care team to focus on the patient's immediate disorder to the exclusion of other health issues, the nurse reminds the patient and family about the importance of participating in health promotion activities, including appropriate health screenings.

Kidney Transplantation

Kidney transplantation has become the treatment of choice for most patients with ESKD. In the United States and globally, there are many more patients on the waiting list for kidney transplantation than there are organ donors. More than 99,000 Americans are on the waiting list to receive a kidney (Organ Procurement and Transplantation Network [OPTN], 2016). In India, the number of people requiring transplantation is estimated to be around 220,000. Against this huge demand, meager 7500 kidney transplantations are performed at the 250 kidney transplant centers across India. Most of the transplants done are live related donors and only 10% are from deceased donors (Shroff, 2016).

Patients choose kidney transplantation for various reasons, such as the desire to avoid dialysis or to improve their sense of well-being and the wish to lead a more normal life. In addition, the cost of maintaining a successful transplantation is one third the cost of dialysis treatment (Trevitt et al., 2012). Kidney transplantation is an elective procedure, not an emergency lifesaving procedure. Therefore, patients should be in the best possible condition prior to transplantation.

Chart 44-13

Kidney Donation

An inadequate number of available kidneys remain the greatest limitation to treating patients with end-stage kidney disease successfully. For those interested in donating a kidney, the Organ India or Organ Donation India provides written information describing the organ donation program and a card specifying the organs to be donated in the event of death.

The organ donation card is signed by the donor and two witnesses and should be carried by the donor at all times. Inform about the intention for organ donation to the family members as soon as organ donation registration process is over. Before harvesting the organs, family members' consent is mandatory. Hence, make them understand the process and insist that organ donation will not cause any disfigurement. Procurement of an adequate number of kidneys for potential recipients is still a major problem in India, despite national legislation that requires relatives of deceased patients or patients declared brain dead to be asked if they would consider organ donation.

Kidney transplantation involves transplanting a kidney from a living or deceased donor to a recipient who no longer has renal function (see Chart 44-13). A living donor is a person who is alive at the time of donation and may or may not be related to the recipient. A deceased or cadaveric transplant comes from someone who has died and donated their organs. Transplantation from well-matched living donors who are related to the patient (those with compatible ABO and human leukocyte antigens) is slightly more successful than from cadaver donors (Gaber, Knight, & Patel, 2013). A contemporary development in kidney transplantation is paired donor exchange. In paired donor exchange, recipients essentially swap willing donors (Gaber et al., 2013). Although medically eligible to donate a kidney, a willing donor may be incompatible with the intended recipient due to blood type or antigens. The donor then agrees to donate the kidney to a compatible and unknown recipient, with the intention that the donor's originally intended organ recipient will be part of the donation chain and be the recipient of a donated kidney through organized donor and recipient matches.

Prior to either receiving or donating an organ, an extensive medical evaluation is performed. Not everyone is suitable for kidney transplantation. Contraindications include recent malignancy, active or chronic infection, severe irreversible extrarenal disease (e.g., inoperable cardiac disease, chronic lung disease, severe peripheral vascular disease), active infection (e.g., HIV, hepatitis B and C), Class II obesity (body mass index greater than 35 kg/m^2), current substance abuse, inability to give informed consent, and history of nonadherence to treatment regimens (Dring & Hipkiss 2015). Donors may be rejected for the same reasons or any condition that is determined to have an impact on the remaining kidney. Examples include hypertension and diabetes because both are known causes of kidney disease. It is imperative when donors are evaluated that serious consideration be given to the overall long-term health of the donor. Every precaution must be taken to ensure that the remaining kidney in the donor will remain healthy. If these conditions are met, the donor should remain healthy after donation and have a normal lifespan. Because one kidney can easily handle the body's needs, no long-term adjustments will need to be made.

The recipient's native kidneys are not usually removed. The transplanted kidney is placed in the patient's iliac fossa anterior to the iliac crest because it allows for easier access to the blood supply needed to perfuse the kidney. The ureter of the newly transplanted kidney is transplanted into the bladder or anastomosed to the ureter of the recipient (see Fig. 44-12). Once the blood supply has been reestablished to the transplanted kidney in the operating room, urine should begin to flow. The production of urine at this stage is an important indicator of the overall success of the procedure and ultimate long-term outcome.

Preoperative Management

Preoperative management goals include bringing the patient's metabolic state to a level as close to normal as possible through

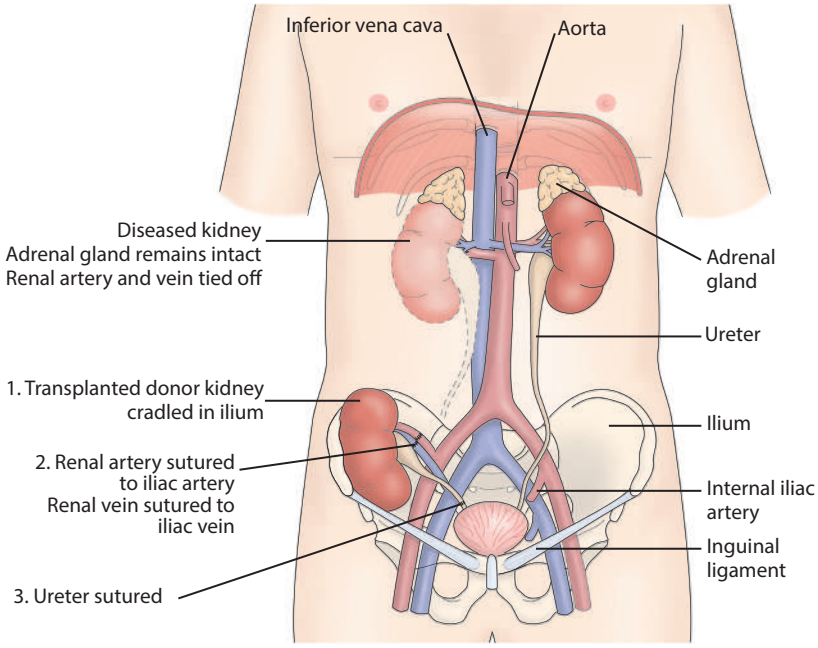


Figure 44-12 • Kidney transplantation. **1.** The transplanted kidney is placed in the iliac fossa. **2.** The renal artery of the donated kidney is sutured to the iliac artery, and the renal vein is sutured to the iliac vein. **3.** The ureter of the donated kidney is sutured to the bladder or to the patient's ureter.

diet, possibly dialysis and medical management, making sure that the patient is free of infection, and preparing the patient for surgery and the postoperative course.

Medical Management

A complete physical examination is performed on the donor and the recipient to detect and treat any conditions that could cause complications after the donor and transplantation procedure. Tissue typing, blood typing, and antibody screening are performed to determine compatibility of the tissues and cells of the donor and recipient. Other diagnostic tests must be completed to identify conditions requiring treatment before transplantation for either individual. The lower urinary tract is studied to assess bladder neck function and to detect ureteral reflux.

Both patients must be free of infection at the time of kidney transplantation. After surgery, medications to prevent transplant rejection will be prescribed to the transplant recipient. These medications suppress the immune response, leaving the patient immunosuppressed and at risk for infection. Therefore, both the donor and recipient are evaluated and treated for any infections, including gingival (gum) disease and dental caries.

A psychosocial evaluation is conducted to assess the organ recipient's ability to adjust to the transplant, coping styles, social history, social support available, and financial resources. A history of psychiatric illness is important to obtain because psychiatric conditions are often aggravated by the corticosteroids needed for immunosuppression after transplantation (Colaneri, 2014). A psychosocial evaluation is also conducted to assess the organ donor's motive for giving the organ. The donor should not be coerced to donate this organ; it should be an altruistic act (Choudhury, Jotterand, Casenave, et al., 2014); (Robbins, 2014) (see Chart 44-14). If a dialysis routine has been established, hemodialysis is often performed the day before the scheduled transplantation procedure to optimize the physical status of the patient receiving the transplant.

Nursing Management

The nursing aspects of preoperative care for the patient undergoing kidney transplant and donation are similar to those for patients undergoing other types of kidney or elective abdominal surgery. Preoperative education can be conducted in a variety of settings, including the outpatient preadmission area, the hospital, or the transplantation clinic during the preliminary workup phase. Patient education directed at the kidney transplant donor and recipient addresses postoperative pulmonary hygiene, pain management options, dietary restrictions, IV and arterial lines, tubes (indwelling catheter and possibly a nasogastric tube), and early ambulation. Most patients have been on dialysis for months or years before transplantation. Many have waited months to years for a kidney transplant and are anxious about the surgery, possible rejection, and the need to return to or begin dialysis. Helping the patient to deal with these concerns is part of the nurse's role in preoperative management, as is educating the patient about what to expect after surgery.

Chart 44-14 ETHICAL DILEMMA

The Gift of Life for Whom? Whose Life is It?

Case Scenario

You are a nurse working in a solid organ transplant clinic that is affiliated with a university health science center. A 52-year-old man with a history of type 2 diabetes and end-stage kidney disease and each of his three biologic siblings, none of whom have diabetes, have been worked up to see if one may be a match for a living transplant. The youngest sibling, who is the only sister in the family, is a perfect donor match. The patient assumes that his sister will donate a kidney, which will improve his quality of life. However, the sister confides in you when other family members are not present, "You know, his need for a kidney is because he never managed his diabetes and everyone is pressuring me into donating. I'm not really certain I want to do this. What if I need this kidney one day?"

Discussion

Living donor transplants offer the best possibility for successful organ engraftment. Biologic siblings are the best candidates for finding good organ matches; there is a greater likelihood that siblings will share all human leukocyte antigens. Patient advocacy and informed consent are imperative as a potential living donor contemplates donating an organ. The Transplantation of Human Organs (THO) Act in 1994 enacted by the Government of India mandates that all transplant centers provide any potential donor with an unbiased advocate. The goal is to ensure that the donor is mentally competent, adequately educated about the risks of the procedure, and capable of autonomous decision making. The THO Act mandates that the donor appears before the authorization Committee which counter checks the mental soundness of the donor to make the decision of organ donation voluntarily and not by any coercion.

Analysis

- Describe the ethical principles that are in conflict in this case (see Chapter 2, Chart 2-3). Which principle should have preeminence as you proceed to work with the potential living donor?
- There are two patients in this case—one is the brother with end-stage kidney disease who is hoping to receive a donated kidney from a sibling, and the other is the sister with healthy kidneys who is reluctant to donate one to her brother. Should the autonomous right of one patient have preeminence over the autonomous right of the other? How would you respond to the sister when she confides in you?
- For whom is there an obligation to advocate for in this situation—the brother, the sister, or the extended family? What resources might you mobilize to help them reconcile their differences?
- Is it morally ethical to donate an organ to a patient whose noncompliance in the management of their disease may have directly caused the organ to fail?

Resources

Choudhury, D., Jotterand, F., Casenave, G., et al. (2014). Independent donor ethical assessment: Aiming to standardize donor advocacy. Progress in transplantation, 24(2), 163–168.

Dhanwate, A. D. (2014). Brainstem death: A comprehensive review in Indian perspective. Indian Journal of Critical Care Medicine, 18(9), 596–605.

Robbins, K. C. (2014). The independent living donor advocate: An essential role for living kidney donation. Nephrology Nursing Journal, 41(6), 569–586.

Transplantation of Human Organs and tissue rules. (2014). The Gazette of India, REGD. NO. D. L.-33004/99. Retrieved on 7/29/2018 at https://www.latestlaws.com/bare-acts/central-acts-rules/medical-health-laws/the-transplantation-of-human-organs-act-1994/transplantation-human-organs-tissues-rules2014

See Chapter 2, Chart 2-6 for ethics resources.

The patient who receives a kidney from a living related donor is often concerned about the donor and how the donor will tolerate the surgical procedure. If the patient is receiving a cadaveric donor transplant, the recipient may express sadness and grief over the loss of the donor's life. The nurse must maintain open communication with the recipient of the organ and allow the patient to express these concerns.

The nurse working in an intensive care setting may provide care to the organ donor who is brain dead prior to organ removal. The overall goal is to preserve the function of the organs through maintaining hemodynamic stability, decreasing the risk for infection, and monitoring laboratory values while providing dignified care to the donor and family members (Derkowski, 2014). Continuing care for the donor can be complex and last several hours. Care is often provided in collaboration with the organ procurement coordinator and transplant coordinator.

Postoperative Management

The goal of postoperative care is to maintain homeostasis until the transplanted kidney is functioning well. The patient whose kidney functions immediately has a more favorable prognosis than the patient whose kidney does not.

Often, the organ donor will be on the same unit as the transplant recipient. The donor will require the same level of care provided to the recipient, including follow-up after the procedure and lifelong. The organ donor may experience more pain than the recipient, possibly requiring more analgesia for pain control. Fluid, electrolyte, and hemodynamic status will also be closely monitored in the organ donor.

Medical Management

After a kidney transplantation, rejection and failure can occur within 24 hours (hyperacute), within 3 to 14 days (acute), or after many years. A hyperacute rejection is caused by an immediate antibody-mediated reaction that leads to generalized glomerular capillary thrombosis and necrosis. An acute rejection typically occurs within a few days to weeks of the transplant surgery, and the patient experiences tenderness at the transplant site, a decrease in serum creatinine values, fever, malaise, and oliguria (Colaneri, 2014). An acute rejection requires early recognition and treatment with immunosuppressant therapy, whereas a hyperacute reaction requires immediate removal of the transplanted organ (Colaneri, 2014). The long-term survival of a transplanted kidney depends on how well it matches the recipient and how well the body's immune response is controlled. The body's immune system views the transplanted kidney as "foreign"; therefore, it continually works to reject it. To overcome or minimize the body's defense mechanisms, immunosuppressive agents are given. Optimally, medications modify the immune system enough to prevent rejection, although not enough to allow infections or malignancies to occur (see Table 44-4).

Combinations of corticosteroids and medications specifically developed to affect the action of lymphocytes are used to minimize the body's reaction to the transplanted organ. Treatment with combinations of new agents has dramatically improved survival rates, and now 90% to 95% of transplanted kidneys still function after 1 year (Colaneri, 2014). Doses of immunosuppressive agents are often adjusted depending on the patient's immunologic response to the transplant. However, the patient will be required to take some form of immunosuppressive therapy for the entire time that they have the transplanted kidney.

The risks associated with taking these medications include nephrotoxicity, hypertension, hyperlipidemia, hirsutism, tremors, blood dyscrasias, cataracts, gingival hyperplasia, and several types of cancer (Colaneri, 2014).

Nursing Management

Assessing the Patient for Transplant Rejection

After kidney transplantation, the nurse assesses the patient for signs and symptoms of transplant rejection: oliguria, edema, fever, increasing blood pressure, weight gain, and swelling or tenderness over the transplanted kidney or graft. Patients receiving cyclosporine (Neoral) may not exhibit the usual signs and symptoms of acute rejection. In these patients, the only sign may be an asymptomatic rise in the serum creatinine level (more than a 20% rise is considered acute rejection) (Colaneri, 2014).

Preventing Infection

The results of blood chemistry tests and leukocyte and platelet counts are monitored closely because immunosuppression depresses the formation of leukocytes and platelets. The patient is closely monitored for infection because of susceptibility to impaired healing and infection related to immunosuppressive therapy and complications of kidney disease. Clinical manifestations of infection include shaking chills, fever, rapid heartbeat (tachycardia), and respirations (tachypnea), as well as either an increase or a decrease in WBCs (leukocytosis or leukopenia).

Infection may be introduced through many sources. Urine cultures are performed frequently because of the high incidence of bacteriuria during early and late stages of transplantation. Any type of wound drainage should be viewed as a potential source of infection because drainage is an excellent culture medium for bacteria. Catheter and drain tips may be cultured when removed by cutting off the tip of the catheter or drain (using aseptic technique) and placing the tip in a sterile container to be taken to the laboratory for culture (see Chart 44-15).

The nurse ensures that the patient is protected from exposure to infection by hospital staff, visitors, and other patients with active infections. Attention to hand hygiene by all who come in contact with the patient is imperative.

Monitoring Urinary Function

A kidney from a living donor who is related to the patient usually begins to function immediately after surgery and may produce large quantities of dilute urine. A kidney from a cadaver donor may undergo ATN and therefore may not function for 2 or 3 weeks, during which time anuria, oliguria, or polyuria may be present. During this stage, the patient may experience significant changes in fluid and electrolyte status. Therefore, careful monitoring is indicated. The output from the urinary catheter (connected to a closed drainage system) is measured every hour. IV fluids are given on the basis of urine volume and serum electrolyte levels and as prescribed by the primary provider. Hemodialysis may be necessary postoperatively to maintain homeostasis until the transplanted kidney is functioning well. It also may be required if fluid overload and hyperkalemia occur. After successful kidney transplantation, the vascular access device may clot, possibly from improved coagulation with the return of renal function. The vascular access for hemodialysis is monitored to ensure patency and to evaluate for evidence of infection.

Addressing Psychological Concerns

The rejection of a transplanted kidney is of great concern to the patient, the family, and the health care team for many

TABLE 44-4 Immunosuppressant Agents Used Following Organ Transplant

Agent	Action	Nursing Implications
Azathioprine (Azasan, Imuran)	Antagonizes purine metabolism and appears to inhibit DNA, RNA, and normal protein synthesis in rapidly growing cells; suppresses T-cell effects	Give oral drug in divided doses with food. Monitor leukocyte and platelet counts and bleeding.
Belatacept (Nulojix)	Inhibition of T-lymphocyte proliferation and cytokine production	Contraindicated in patients with EBV seronegativity or unknown EBV serostatus, liver transplantation, breast-feeding. Monitor for symptoms of infection, hypertension, progressive multifocal leukoencephalopathy. Administer IV.
Cyclosporine (Gengraf, Neoral, Sandimmune)	Selective and reversible inhibition of first phase of T-cell activation with T lymphocytes	Do not dilute oral solution with grapefruit juice (use orange juice, regular or chocolate milk, or apple juice and administer immediately after mixing). Observe for adverse reactions for 30 minutes after initiation of the IV infusion. Be aware that nephrotoxicity is reported in up to 1/3 of transplant recipients. Give medication with food to reduce gastrointestinal upset. Administer medication at the same time each day.
Everolimus (Afinitor, Zortess)	Protein–tyrosine kinase inhibitor	Monitor for hypersensitivity reaction. Watch for changes in pulmonary status and cough. Avoid administration of live vaccines. Administer at the same time each day with food; do not crush or allow patient to chew tablet.
Mycophenolate mofetil (CellCept) Mycophenolic acid (Myfortic)	Inhibition of T- and B-lymphocyte responses, thus inhibiting antibody formation and generation of cytotoxic T cells	Administer on an empty stomach. Do not crush or open capsules. Avoid contact with powder in capsules; wash thoroughly with soap and water if contact occurs. Obtain baseline complete blood count with differential prior to initiating therapy. Instruct the patient to avoid over-the-counter antacids.
Prednisone (Apo-Prednisone, Deltasone, Orasone, Panasol, Winpred)	Immediate-acting synthetic analog of hydrocortisone that has anti-inflammatory and immunosuppressant properties	Give with meals or a snack. Crush tablet and give with fluid if patient is unable to swallow it whole. Note that the drug should not be stopped abruptly; the dosage is reduced gradually. Monitor weight, blood pressure, blood glucose levels, and sleep patterns. Monitor for hypocalcemia. Instruct patient to avoid or minimize alcohol intake.
Sirolimus (Rapamune)	Inhibits the response of helper T and B lymphocytes	Administer 4 hours after oral cyclosporine. Instruct patient to swallow tablets whole and to avoid chewing or crushing tablets. Refrigerate drug and protect from light. Instruct patient to avoid grapefruit juice within 2 hours of taking drug and to mix the drug only with orange juice or water. Instruct the patient to limit exposure to sunlight.
Tacrolimus (Prograf)	Inhibits helper T lymphocytes	Monitor for neurotoxicity (tremors and changes in mental status). Assess for hypertension. Monitor tacrolimus levels.

DNA, deoxyribonucleic acid; EBV, Epstein-Barr virus; IV, intravenous; RNA, ribonucleic acid.
Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

months. The fear of kidney rejection and the complications of immunosuppressive therapy (Cushing syndrome, diabetes, capillary fragility, osteoporosis, glaucoma, cataracts, acne, nephrotoxicity) place tremendous psychological stress on the patient. If the organ donor was a family member there may be added feelings of guilt and anger that need to be addressed. Anxiety and uncertainty about the future and difficult adjustment are often sources of stress for the patient and family.

An important nursing function is the assessment of the patient's stress and coping. The nurse uses each visit with the patient to determine if the patient and family are coping effectively and the patient is adhering to the prescribed medication regimen. If indicated or requested, the nurse refers the patient for counseling.

Monitoring and Managing Potential Complications

The patient undergoing kidney transplantation is at risk for the postoperative complications that are associated with any surgical procedure. In addition, the patient's physical condition may be compromised because of the effects of long-standing kidney disease and its treatment. Therefore, careful assessment of the complications related to kidney disease and those associated with a major surgery are important aspects of nursing care.

Chart 44-15

Kidney Transplant Rejection and Infection

Renal graft rejection and failure may occur within 24 hours (hyperacute), within 3–14 days (most commonly acute), or after many years (most commonly chronic). It is not uncommon for rejection to occur during the first year after transplantation.

Detecting Rejection

Ultrasonography may be used to detect enlargement of the kidney; percutaneous renal biopsy (most reliable) and x-ray techniques are used to evaluate transplant rejection. If the body rejects the transplanted kidney, the patient needs to commence dialysis. The rejected kidney may or may not be removed, depending on when the rejection occurs (acute vs. chronic) and the risk for infection if the kidney is left in place.

Potential Infection

About 75% of kidney transplant recipients have at least one episode of infection in the first year after transplantation because of immunosuppressant therapy. Immunosuppressants of the past made the transplant recipient more vulnerable to opportunistic infections (candidiasis, cytomegalovirus, Pneumocystis pneumonia) and infection with other relatively nonpathogenic viruses, fungi, and protozoa, which can be a major hazard. Immunosuppressive therapy, such as cyclosporine (Neoral) has reduced the incidence of opportunistic infections because it selectively exerts its effect, sparing T cells that protect the patient from life-threatening infections. In addition, combination immunosuppressant therapy and improved clinical care have produced 1-year patient survival rates approaching 100% and graft survival exceeding 90%. Infections, however, remain a major cause of death at all points in time for kidney transplant recipients.

Adapted from Colaneri, J. (2014). An overview of transplant immunosuppression—History, principles, and current practices in kidney transplantation. Nephrology Nursing Journal, 41(6), 549–560.

Breathing exercises, early ambulation, and care of the surgical incision are important aspects of postoperative care.

GI ulceration and corticosteroid-induced bleeding may occur. Fungal colonization of the GI tract (especially the mouth) and urinary bladder may occur secondary to corticosteroid and antibiotic therapy. Closely monitoring the patient and notifying the primary provider about the occurrence of these complications are important nursing interventions. In addition, the patient is monitored closely for signs and symptoms of adrenal insufficiency if the treatment has included the use of corticosteroids.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

The nurse works closely with the patient and family to be sure that they understand the need for continuing immunosuppressive therapy as prescribed. In addition, the patient and family are instructed to assess for and report signs and symptoms of transplant rejection, infection, or significant adverse effects of the immunosuppressive regimen. These include decreased urine output; weight gain; malaise; fever; respiratory distress; tenderness over the transplanted kidney; anxiety; depression; changes in eating, drinking, or other habits; and changes in blood pressure. The patient is instructed to inform other health care providers (e.g., dentist) about the kidney transplant and the use of immunosuppressive agents.

Continuing and Transitional Care

The patient needs to know that follow-up care after transplantation is a lifelong necessity. Individual verbal and written instructions are provided concerning diet, medication, fluids, daily weight, daily measurement of urine, management of I&O, prevention of infection and chronic rejection, resumption of activity, and avoidance of contact sports in which the transplanted kidney may be injured. Because of the risk of other potential complications, the patient is followed closely by a health care team that includes the nephrologist, transplant surgeon, transplant coordinator or nurse, social worker, and dietician. Medications are often obtained at one pharmacy or through the pharmacy at the hospital where the transplant surgery was performed for the purpose of quality control. Follow-up with providers from the transplant team will initially occur once a week upon discharge from the hospital and taper with time. Laboratory studies will also be obtained and followed on an ongoing basis to monitor the function of the kidney.

Cardiovascular disease is the major cause of morbidity and mortality after transplantation, due in part to the increasing age of patients with transplants. An additional problem is possible malignancy; patients receiving long-term immunosuppressive therapy are at higher risk for cancers than the general population. The nurse reminds the patient of the importance of health promotion and health screening and provides information on local transplantation support groups at the transplant hospital or through the procurement organization.

RENAL TRAUMA

The kidneys are protected by the rib cage and musculature of the back posteriorly and by a cushion of abdominal wall and viscera anteriorly. They are highly mobile and are fixed only at the renal pedicle (stem of renal blood vessels and the ureter). With traumatic injury, the kidneys can be thrust against the lower ribs, resulting in contusion and rupture. Rib fractures or fractures of the transverse process of the upper lumbar vertebrae may be associated with renal contusion or laceration. Failure to wear seat belts contributes to the incidence of renal trauma in motor vehicle crashes. Up to 80% of patients with renal trauma have associated injuries of other internal organs.

Injuries may be blunt (automobile and motorcycle crashes, falls, athletic injuries, assaults) or penetrating (gunshot wounds, stabbings). Blunt renal trauma accounts for 80% to 90% of all renal injuries; penetrating renal trauma accounts for the remaining 10% to 20% (Counts, 2015); (USRDS, 2015).

Blunt renal trauma is classified into one of four groups, as follows:

- Contusion: Bruises or hemorrhages under the renal capsule; capsule and collecting system intact
- Minor laceration: Superficial disruption of the cortex; renal medulla and collecting system are not involved
- Major laceration: Parenchymal disruption extending into cortex and medulla, possibly involving the collecting system
- Vascular injury: Tears of renal artery or vein

The most common renal injuries are contusions, lacerations, ruptures, and renal pedicle injuries or small internal lacerations of the kidney (see Fig. 44-13). The kidneys receive half of the blood flow from the abdominal aorta; therefore, even a fairly small renal laceration can produce massive bleeding. The majority of patients are in shock when admitted to the hospitals. In some cases, there is an isolated renal artery thrombosis.

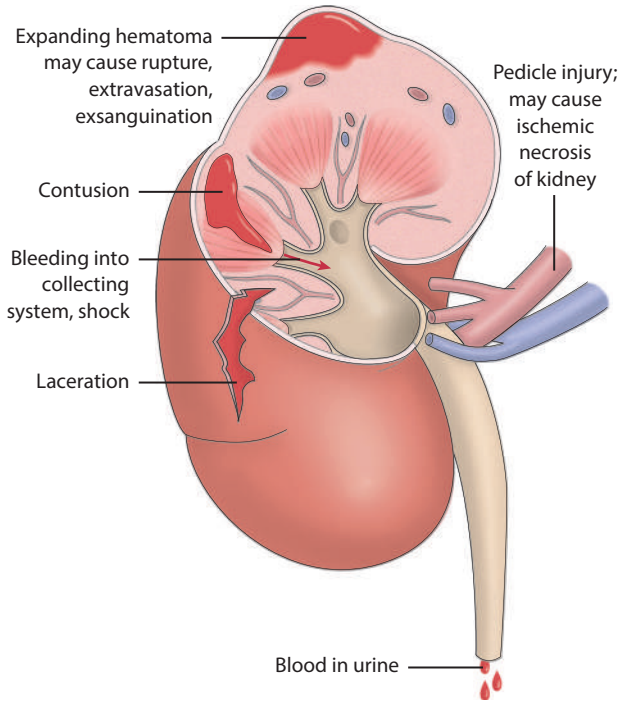


Figure 44-13 • Types and pathophysiologic effects of kidney injuries: contusions, lacerations, rupture, and pedicle injury.

Clinical manifestations include pain, renal colic (due to blood clots or fragments obstructing the collecting system), hematuria, mass or swelling in the flank, ecchymoses, and lacerations or wounds of the lateral abdomen and flank. Hematuria is the most common manifestation of renal trauma; its presence after trauma suggests kidney injury. There is no relationship between the degree of hematuria and the degree of injury. Hematuria may not occur, or it may be detectable only on microscopic examination. Signs and symptoms of hypovolemia and shock (see Chapter 8) are likely with significant hemorrhage.

Medical Management

The goals of management in patients with renal trauma are to control hemorrhage, pain, and infection as well as to preserve and restore renal function. All urine is saved and sent to the laboratory for analysis to detect RBCs and to evaluate the course of bleeding. Hematocrit and hemoglobin levels are monitored closely; decreasing values indicate hemorrhage.

The patient is monitored for oliguria and signs of hemorrhagic shock, because a pedicle injury or shattered kidney can lead to rapid exsanguination (lethal blood loss). An expanding hematoma may cause rupture of the kidney capsule. To detect hematoma, the area around the lower ribs, upper lumbar vertebrae, flank, and abdomen is palpated for tenderness. A palpable flank or abdominal mass with local tenderness, swelling, and ecchymosis suggests renal hemorrhage. The area of the original mass can be outlined with a marking pen so that the examiner can evaluate the area for change.

Renal trauma is often associated with other injuries to the abdominal organs (liver, colon, small intestines); therefore, the patient is assessed for skin abrasions, lacerations, and entry and exit wounds of the upper abdomen and lower thorax, because these may be associated with kidney injury.

With a contusion of the kidney, healing may take place with conservative measures. If the patient has microscopic hematuria and a normal IV urogram, outpatient management is possible. If gross hematuria or a minor laceration is present, the patient is hospitalized and kept on bed rest until the hematuria clears. Antimicrobial medications may be prescribed to prevent infection from perirenal hematoma or urinoma (a cyst containing urine). Patients with retroperitoneal hematomas may develop low-grade fever as absorption of the clot takes place.

Surgical Management

In renal trauma, any sudden change in the patient's condition suggests hemorrhage and requires rapid surgical intervention. Depending on the patient's condition and the nature of the injury, major lacerations may be treated through surgical intervention or conservatively (bed rest, no surgery). Vascular injuries require immediate exploratory surgery because of the high incidence of involvement of other organ systems and the serious complications that may result if these injuries are untreated. The patient is often in shock and requires aggressive fluid resuscitation. The damaged kidney may have to be removed (nephrectomy).

Early postoperative complications (within 6 months) include rebleeding, perinephric abscess formation, sepsis, urine extravasation, and fistula formation. Other complications include stone formation, infection, cysts, vascular aneurysms, and loss of renal function. Hypertension can be a complication of any surgery but usually is a late complication of kidney injury.

Nursing Management

The patient with renal trauma must be assessed frequently during the first few days after injury to detect flank and abdominal pain, muscle spasm, and swelling over the flank. During this time, the patient who has undergone surgery is educated about care of the incision and the importance of an adequate fluid intake. In addition, instructions about changes that should be reported to the physician, such as fever, hematuria, flank pain, or any signs and symptoms of decreasing kidney function, are provided. Guidelines for gradually increasing activity, lifting, and driving are also provided in accordance with the physician's prescription.

Follow-up nursing care includes monitoring the blood pressure to detect hypertension and advising the patient to restrict activities for about 1 month after trauma to minimize the incidence of delayed or secondary bleeding. The patient should be advised to schedule periodic follow-up assessments of renal function (creatinine clearance, BUN, and serum creatinine analyses). If a nephrectomy was necessary, the patient is advised to wear medical identification.

CRITICAL THINKING EXERCISES

1. You are a staff nurse in an outpatient dialysis facility. A 40-year-old man with ESKD is seen in the clinic for the first time and states that he wants to begin home hemodialysis. The patient lives alone and is employed full-time. What should be the priorities for educating this patient about the options for dialysis? How should the priorities change if the patient decides on PD?
2. You are caring for a 75-year-old patient who has been recently diagnosed with renal cancer. What is the evidence base for her treatment options? Identify the criteria used to evaluate the strength of the evidence.

3. A 23-year-old man is admitted to the surgical intensive care unit after a motor vehicle crash. The patient sustained multiple abdominal injuries that resulted in intra-abdominal hemorrhage requiring emergent surgery. The patient's blood pressure was 58/42 upon arrival to the emergency department, and the patient was not responsive. Due to broken ribs and a pneumothorax, the patient is also being mechanically ventilated. The nurse notes that the patient's urine output is less than 0.5 mL/kg/hr and that the patient remains hypotensive. Based on the assessment information, what type of AKI is this patient most likely experiencing? Describe the nursing plan of care for this patient.

REFERENCES

*Asterisk indicates nursing research.

Books

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Counts, C. S. (2015). ANNA core curriculum for nephrology nursing (6th ed.). Pitman, NJ: American Nephrology Nurses Association.

Grossman, S. C., & Porth, C. M. (2014). Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

U.S. Renal Data System (USRDS). (2015). Annual data report: Atlas of chronic kidney disease and end-stage renal disease in the United States. Bethesda, MD: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases.

Journals and Electronic Documents

Ahmad, M. M., & Al Nazly, E. K. (2015). Hemodialysis: Stressors and coping strategies. Psychology Health and Medicine, 20(4), 477–487.

American Cancer Society. (2015). Kidney cancer. Retrieved on 1/10/2015 at: www.cancer.org/cancer/kidneycancer/detailedguide/kidney-cancer-adult-key-statistics

Arslanian, J. (2015). Monitoring and surveillance of the hemodialysis vascular access. Nephrology News and Issues, 29(3), 38–42.

Centers for Disease Control and Prevention (CDC). (2014). National chronic kidney disease fact sheet 2014. Retrieved 7/4/2016 at: www.cdc.gov/diabetes/pubs/pdf/kidney_Factsheet.pdf

Choudhury, D., Jotterand, F., Casenave, G., et al. (2014). Independent donor ethical assessment: Aiming to standardize donor advocacy. Progress in transplantation, 24(2), 163–168.

Colaneri, J. (2014). An overview of transplant immunosuppression—History, principles, and current practices in kidney transplantation. Nephrology Nursing Journal, 41(6), 549–560.

Davies, H., & Leslie, G. (2012). Acute kidney injury and the critically ill patient. Dimensions of Critical Care Nursing, 31(3), 135–152.

Deng, D., & Forbes, A. (2015). Cardiovascular risk factors in patients on dialysis. Nephrology Nursing Journal, 42(1), 45–50.

Derkowski, D. (2014). Understanding the changes to the national deceased donor allocation system. Nephrology Nursing Journal, 41(6), 589–591, 608.

Dirkes, S. M. (2014). Continuous renal replacement therapy: Dialysis for critically ill patients. American Nurse Today, 9(5), 8–11.

Doss-McQuitty, S. (2014). Strategies for removing fluids during hemodialysis. Nephrology Nursing Journal, 41(3), 257–263.

Dring, B., & Hipkiss, V. (2015). Managing and treating chronic kidney disease. Nursing Times, 111(7), 16–19.

Elliott, R. W. (2012). Demographics of the older adult and chronic kidney disease: A literature review. Nephrology Nursing Journal, 39(6), 491–496.

Figueiredo, A. E. (2014). The challenges in preventing infection in peritoneal dialysis: A nurse's viewpoint. Renal Society of Australasia Journal, 10(3), 120–125.

Gaber, L. W., Knight, R. J., & Patel, S. J. (2013). A surgeons' guide to renal transplant immunopathology, immunology, and immunosuppression. Surgical Clinics of North America, 93(6), 1293–1307.

Goswami, R., Vohra, B. M., Raju, R., Bharani., & Pahwa. (2016). Clinical profile and outcome of hospital acquired kidney injury versus community acquired acute kidney injury – A prospective study from central India. International Journal of innovative research and review, 4(3), 31-39. Retrieved on May 14th 2018 at http://www.cibtech.org/jirr.htm

Hain, D. J. (2015). Where's the evidence? Care coordination for adults with chronic kidney disease. Nephrology Nursing Journal, 42(1), 77–83.

Hain, D. J., & Chan, J. (2013). Best available evidence for peritoneal dialysis catheter exit-site care. Nephrology Nursing Journal, 40(1), 63–69

Inbanathan, J. & Lavanya, B. U. (21016). Clinical profile of renal involvement in acute gastroenteritis patients. International Journal of Scientific Study, 4(8), 48-52.

James, P. A., Oparil, S., Carter, B. L, et al. (2014). 2014 Evidence-based guidelines for the management of high blood pressure in adults: Report from the panel members appointed to the Eighth Joint National Committee (JNC 8). JAMA, 311(5), 507–520.

Jha, V. (2013). Current state of End stage renal disease care in India and Pakistan Kidney International Supplements (2013) 3, 157–160, retrieved on May 14th, 2018 at https://www.sciencedirect.com/science/article/pii/S2157171615311345

Jha, V & Modi, G. (2017). Uncovering the rising kidney failure deaths in India. The Lancet global health, 5(1), e14-e15. Retrieved on April 5th, 2018 at www.the lancet.com/lancetgh ,

*Kane-Gill, S. L., Sileanu, F. E., Murugan, R., et al. (2015). Risk factors for acute kidney injury in older adults with critical illness: A retrospective cohort study. American Journal of Kidney Diseases, 65(6), 860–869.

Klein-Kauric, Z. (2015). Understanding hypertension in patients on hemodialysis. Nephrology Nursing Journal, 42(1), 69–75.Lewis, R. (2013). An overview of chronic kidney disease in older people. Nursing Older People, 25(10), 31–38.

Ludvigsen, M. S., Hermansen, H. M., & Lindberg, M. (2014). The quality of nursing care during intradialytic fluid removal in hemodialysis: Time to change practice? Journal of Clinical Nursing, 24(11–12), 1733–1736.

*MacRae, J. M., Ahmed, S. B., & Hemmelgam, B. R. (2014). Arteriovenous fistula survival and needling technique: Long-term results from a randomized buttonhole trial. American Journal of Kidney Disease, 63(4), 636–642.

Organ Procurement and Transplantation Network (OPTN). (2016). Waiting list candidates as of today. Retrieved 7/5/2016 at: optn.transplant.hrsa.gov/data/

O'Sullivan, E. D., Hughes, J., & Ferenbach, D. A. (2017). Renal aging: Causes and consequences. Journal of American society of Nephrology, 28(2), 407–420.

Prentice, M. (2013). Conservative care in advanced kidney disease. British Journal of Primary Care Nursing, 10(2), 83–86.

Rank, W. (2013). Preventing contrast media-induced nephrotoxicity. Nursing 2013, 43(4), 48–51.

Richardson, A., & Whatmore, J. (2015). Nursing essential principles: Continuous renal replacement therapy. Nursing in Critical Care, 20(1), 8–15.

Robbins, K. C. (2014). The independent living donor advocate: An essential role for living kidney donation. Nephrology Nursing Journal, 41(6), 569–586.

Shroff, S. (2016). Current trends in kidney transplantation in India. Indian Journal of Urology, 32(3), 173–174.

Taal, M. W. (2013). Chronic kidney disease in general populations and primary care: Diagnostic and therapeutic considerations. Current Opinion in Nephrology and Hypertension, 22(6), 593–598.

Tennankore, K. K., d'Gama, C., Faratro, R., et al. (2015). Adverse technical events in home hemodialysis. American Journal of Kidney Diseases, 65(1), 116–121.

Trevitt, R., Dunsmore, V., Murphy, F., et al. (2012). Pre- and post-transplant care: Nursing management of the renal transplant recipient: Part 2. Journal of Renal Care, 38(2), 107–114.

Vritis, M. C. (2013). Preventing and responding to acute kidney injury. The American Journal of Nursing, 113(4), 38–47.

Varma, P. P. (2015). Prevalence of chronic kidney disease in India - Where are we heading? Indian Journal of Nephrology, 25(3), 133–135.

Walton, B. (2015). Chronic kidney disease. Ohio Nurse, 8(3), 5–6.
*Weiner, D. E., Brunelli, S. M., Hunt, A., et al. (2014). Improving clinical outcomes among hemodialysis patients: A proposal for a "volume first" approach from the chief medical officers of US dialysis providers. American Journal of Kidney Diseases, 64(5), 685–695.
*Wright, L. S., & Wilson, L. (2015). Quality of life and self-efficacy in three dialysis modalities: Incenter hemodialysis, home hemodialysis, and home peritoneal dialysis. Nephrology Nursing Journal, 42(5), 463–476.
*Yamamoto, T., Shoji, S., Yamakawa, T., et al. (2015). Predialysis and postdialysis pH and bicarbonate and risk of all-cause and cardiovascular mortality in long-term hemodialysis patients. American Journal of Kidney Disease, 66(3), 469–478.
Yang Li, (2016). Acute kidney injury in Asia. Kidney Disease, 2, 95-102. Retrieved on April 5th, 2018 at https://www.karger.com/Article/Pdf/441887
Yuvaraja, T. B., Waigankar, S., Bakshi, G., & Praksh, G. (2016). Genitourinary cancers: Summary of Indian Data. South Asian Journal of Cancer, 5(3), 122–124 retrieved on May 14th, 2018 at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4991131/

Resources

American Association of Kidney Patients (AAKP), www.aakp.org
American Kidney Fund, www.kidneyfund.org
American Nephrology Nurses' Association (ANNA), www.annanurse.org
American Urological Association (AUA), www.auanet.org
Arteriovenous Fistula First, www.fistulafirst.org
Indian organ transplant registry, http://www.transplantindia.com/
National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), www.niddk.nih.gov
National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC), digestive.niddk.nih.gov
National Kidney Foundation (NKF), www.kidney.org
Organ donation India, http://donatelifeindia.org/
Organ India, http://www.organindia.org/all-about-organ-donation/
United Network for Organ Sharing (UNOS), www.unos.org
United States Renal Data System (USRDS, www.usrds.org

CHAPTER 45

Management of Patients with Urinary Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Explain the factors contributing to upper and lower urinary tract infections (UTIs).
2. Use the nursing process as a framework for care of the patient with a lower UTI.
3. Differentiate between the various adult dysfunctional voiding patterns.
4. Develop an education plan for a patient who has mixed (stress and urge) urinary incontinence.
5. Identify potential causes of an obstruction of the urinary tract along with the medical and surgical management of the patient with this condition.
6. Apply the nursing process as a framework for care of the patient with kidney stones.
7. Describe the pathophysiology, clinical manifestations, medical management, and nursing management for patients with genitourinary trauma and urinary tract cancers.
8. Use the nursing process as a framework for care of the patient undergoing urinary diversion surgery.

GLOSSARY

bacteriuria: bacteria in the urine
cystectomy: surgical removal of the urinary bladder
cystitis: inflammation of the urinary bladder
ileal conduit: transplantation of the ureters to an isolated section of the terminal ileum, with one end of the ureters brought to the abdominal wall
interstitial cystitis: inflammation of the bladder wall that eventually causes disintegration of the lining and loss of bladder elasticity
micturition: voiding or urination
neurogenic bladder: bladder dysfunction that results from a disorder or dysfunction of the nervous system and leads to urinary incontinence
nocturia: awakening at night to urinate
overflow incontinence: involuntary urine loss associated with overdistention of the bladder
prostatitis: inflammation of the prostate gland
pyelonephritis: inflammation of the renal pelvis
pyuria: white blood cells in the urine
residual urine: urine that remains in the bladder after voiding
suprapubic catheter: a urinary catheter that is inserted through a suprapubic incision into the bladder
ureterosigmoidostomy: transplantation of the ureters into the sigmoid colon, allowing urine to flow through the colon and out the rectum
ureterovesical or vesicoureteral reflux: backward flow of urine from the bladder into one or both ureters
urethritis: inflammation of the urethra
urethrovesical reflux: An obstruction to free-flowing urine leading to the reflux of urine from the urethra into the bladder
urinary frequency: voiding more often than every 3 hours
urinary incontinence: involuntary or uncontrolled loss of urine from the bladder
urosepsis: spread of infection from the urinary tract to the bloodstream that results in a systemic infection

Introduction

The urinary system is responsible for providing the route for drainage of urine formed by the kidneys. Care of the patient with disorders of the urinary tract requires an understanding of the anatomy, physiology, diagnostic testing, medical, and nursing care, as well as rehabilitation of patients with the multiple processes that affect the urinary system. Nurses care for patients with urologic disorders in all settings. This chapter focuses on the nursing management of patients with common urinary dysfunctions, including infections, dysfunctional voiding patterns, urolithiasis, genitourinary trauma, cancer of the urinary tract, and urinary diversions.

INFECTIONS OF THE URINARY TRACT

Urinary tract infections (UTIs) are caused by pathogenic microorganisms in the urinary tract (the normal urinary tract is sterile above the urethra). UTIs are generally classified as infections involving the upper or lower urinary tract and further classified as uncomplicated or complicated, depending on other patient-related conditions (see Chart 45-1).

Lower UTIs include bacterial cystitis (inflammation of the urinary bladder), bacterial prostatitis (inflammation of the prostate gland), and bacterial urethritis (inflammation of the urethra). Acute or chronic nonbacterial causes of inflammation in any of these areas can be misdiagnosed as bacterial infections. Upper UTIs are much less common and include acute or chronic pyelonephritis (inflammation of the renal pelvis), interstitial nephritis (inflammation of the kidney), and kidney abscesses. Upper and lower UTIs are further classified as uncomplicated or complicated, depending on whether the UTI is recurrent and the duration of the infection. Most uncomplicated UTIs are community acquired (Hopkins, McCroskey, Reeves, et al., 2014). Complicated UTIs usually occur in people with urologic abnormalities or recent catheterization and are often acquired during hospitalization.

A UTI is the second most common infection in the body followed by respiratory infections. Most cases occur in women;

Chart 45-1

Classifying Urinary Tract Infections

Urinary tract infections (UTIs) are classified by location: the lower urinary tract (which includes the bladder and structures below the bladder) or the upper urinary tract (which includes the kidneys and ureters). They can also be classified as uncomplicated or complicated UTIs.

Lower UTIs

Cystitis, prostatitis, urethritis

Upper UTIs

Acute pyelonephritis, chronic pyelonephritis, renal abscess, interstitial nephritis, perirenal abscess

Uncomplicated Lower or Upper UTIs

Community-acquired infection; common in young women and not usually recurrent

Complicated Lower or Upper UTIs

Often acquired in the hospital and related to catheterization; occur in patients with urologic abnormalities, pregnancy, immunosuppression, diabetes, and obstructions and are often recurrent

Chart 45-2 RISK FACTORS

Urinary Tract Infection

- Contributing conditions such as:
  - Female gender
  - Diabetes
  - Pregnancy
  - Neurologic disorders
  - Gout
  - Altered states caused by incomplete emptying of the bladder and urinary stasis
- Decreased natural host defenses or immunosuppression
- Inability or failure to empty the bladder completely
- Inflammation or abrasion of the urethral mucosa
- Instrumentation of the urinary tract (e.g., catheterization, cystoscopic procedures)
- Obstructed urinary flow caused by:
  - Congenital abnormalities
  - Urethral strictures
  - Contracture of the bladder neck
  - Bladder tumors
  - Calculi (stones) in the ureters or kidneys
  - Compression of the ureters

Adapted from Hagerty, T., Kertesz, L., Schmidt, J. M., et al. (2015). Risk factors for catheter associated urinary tract infections in critically ill patients with subarachnoid hemorrhage. Journal of Neuroscience Nursing, 47(1), 51–54; Hopkins, L., McCroskey, D., Reeves, G., et al. (2014). Implementing a urinary tract infection clinical practice guideline in an ambulatory urgent care practice. The Nurse Practitioner, 39(4), 50–54.

approximately 50% of women develop at least one episode of UTI during their lifetime. The urinary tract infection is the cause for seeking medical consultation in 5% of general practitioner visits (Singh, Katiyar, Tilak, et al., 2018). Urinary tract is the most common site of nosocomial infection, accounting for 71% of the total number reported by a tertiary care hospital in South India (Narendrnath.et al., 2017). In most of these hospital-acquired UTIs, instrumentation of the urinary tract or catheterization is the precipitating cause.

Lower Urinary Tract Infections

Several mechanisms maintain the sterility of the bladder: the physical barrier of the urethra, urine flow, ureterovesical junction competence, various antibacterial enzymes and antibodies, and antiadherent effects mediated by the mucosal cells of the bladder. Abnormalities or dysfunctions of these mechanisms are contributing risk factors for lower UTIs (see Chart 45-2).

Pathophysiology

For infection to occur, bacteria must gain access to the bladder, attach to and colonize the epithelium of the urinary tract to avoid being washed out with voiding, evade host defense mechanisms, and initiate inflammation. Many UTIs result from fecal organisms ascending from the perineum to the urethra and the bladder and then adhering to the mucosal surfaces.

Bacterial Invasion of the Urinary Tract

By increasing the normal slow shedding of bladder epithelial cells (resulting in bacteria removal), the bladder can clear large numbers of bacteria. Glycosaminoglycan (GAG), a hydrophilic protein, normally exerts a nonadherent protective effect against various bacteria. The GAG molecule attracts water molecules, forming a water barrier that serves as a defensive layer between the bladder and the urine. GAG may be impaired by certain agents (cyclamate, saccharin, aspartame, and tryptophan metabolites). The normal bacterial flora of the vagina and urethral area also interfere with adherence of *Escherichia coli.* Urinary immunoglobulin A (IgA) in the urethra may also provide a barrier to bacteria.

Reflux

An obstruction to free-flowing urine is a condition known as urethrovesical reflux, which is the reflux (backward flow) of urine from the urethra into the bladder (see Fig. 45-1). With coughing, sneezing, or straining, the bladder pressure increases, which may force urine from the bladder into the urethra. When the pressure returns to normal, the urine flows back into the bladder, bringing into the bladder bacteria from the anterior portions of the urethra. Urethrovesical reflux is also caused by dysfunction of the bladder neck or urethra. The urethrovesical angle and urethral closure pressure may be altered with menopause, increasing the incidence of infection in postmenopausal women. Reflux is most often noted in young children, and treatment is based on its severity.

Ureterovesical or vesicoureteral reflux refers to the backward flow of urine from the bladder into one or both ureters (see Fig. 45-1). Normally, the ureterovesical junction prevents urine from traveling back into the ureter. The ureters tunnel into the bladder wall so that the bladder musculature compresses a small portion of the ureter during normal voiding. When the ureterovesical valve is impaired by congenital causes or ureteral abnormalities, the bacteria may reach the kidneys and eventually destroy them.

Uropathogenic Bacteria

Bacteriuria is the term used to describe the presence of bacteria in the urine. Because urine samples (especially in women) can be easily contaminated by the bacteria normally present in the urethral area, a clean-catch midstream urine specimen is the

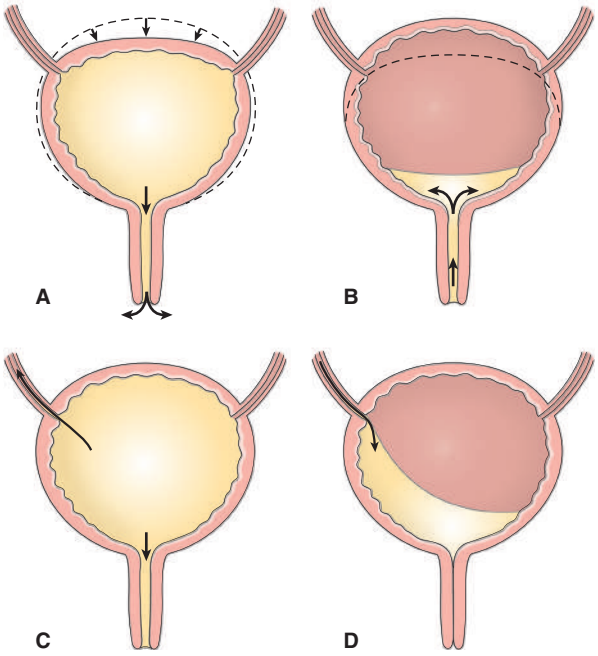


Figure 45-1 • Mechanisms of urethrovesical and ureterovesical reflux may cause urinary tract infection. *Urethrovesical reflux*: With coughing and straining, bladder pressure rises, which may force urine from the bladder into the urethra. **A**. When bladder pressure returns to normal, the urine flows back to the bladder (**B**), which introduces bacteria from the urethra to the bladder. *Ureterovesical reflux*: With failure of the ureterovesical valve, urine moves up the ureters during voiding (**C**) and flows into the bladder when voiding stops (**D**). This prevents complete emptying of the bladder. It also leads to urinary stasis and contamination of the ureters with bacteria-laden urine.

measure used to establish bacteriuria. In men, contamination of the collected urine sample occurs less frequently. Bacteriuria is defined as 100,000 colony-forming units (CFU)/mL urine (Fischbach & Dunning, 2015); (Grossman & Porth, 2014). Community-acquired UTIs are among the most common bacterial infections in women (Hopkins, et al., 2014).The organisms most frequently responsible for UTIs are those normally found in the lower gastrointestinal (GI) tract, usually *Escherichia coli* (Grossman & Porth, 2014).

Routes of Infection

Bacteria enter the urinary tract in three ways: by the transurethral route (ascending infection), through the bloodstream (hematogenous spread), or by means of a fistula from the intestine (direct extension).

The most common route of infection is transurethral, in which bacteria (often from fecal contamination) colonize the periurethral area and subsequently enter the bladder by means of the urethra (Grossman & Porth, 2014). In women, the short urethra offers little resistance to the movement of uropathogenic bacteria. Sexual intercourse forces the bacteria from the urethra into the bladder. This accounts for the increased incidence of UTIs in sexually active women. Bacteria may also enter the urinary tract by means of the blood from a distant site of infection or through direct extension by way of a fistula from the intestinal tract.

Clinical Manifestations

Signs and symptoms of UTI depend on whether the infection involves the lower (bladder) or upper (kidney) urinary tract and whether the infection is acute or chronic. Signs and symptoms of an uncomplicated lower UTI include burning on urination, urinary frequency (voiding more than every 3 hours), urgency, nocturia (awakening at night to urinate), incontinence, and suprapubic or pelvic pain. Hematuria and back pain may also be present. In older adults, these symptoms are less common (see Gerontologic Considerations section).

In patients with complicated UTIs, manifestations can range from asymptomatic bacteriuria to gram-negative sepsis with shock. Complicated UTIs often are caused by a broader spectrum of organisms, have a lower response rate to treatment, and tend to recur. Many patients with catheter-associated UTIs are asymptomatic; however, any patient with a catheter who suddenly develops signs and symptoms of septic shock should be evaluated for urosepsis (the spread of infection from the urinary tract to the bloodstream that results in a systemic infection).

Gerontologic Considerations

The incidence of bacteriuria in older adults differs from that in younger adults. Bacteriuria increases with age and disability, and women are affected more frequently than men. UTI is the most common infection of older adults and increases in prevalence with age. UTIs occur more frequently in women than in men at younger ages but the gap between the sexes narrows in later life, which is due to reduced sexual intercourse in women and a higher incidence of bladder outlet obstruction secondary to benign prostatic hyperplasia in men (Eliopoulos, 2018).

In older adults, structural abnormalities secondary to decreased bladder tone, neurogenic bladder (dysfunctional bladder) secondary to stroke, or autonomic neuropathy of diabetes may prevent complete emptying of the bladder and increase the risk of UTI (Eliopoulos, 2018). When indwelling catheters are used, the risk of UTI increases dramatically (Hagerty, Kertesz, Schmidt, et al., 2015). Older women often have incomplete emptying of the bladder and urinary stasis. In the absence of estrogen, postmenopausal women are susceptible to colonization and increased adherence of bacteria to the vagina and urethra. Oral or topical estrogen has been used to restore the glycogen content of vaginal epithelial cells and an acidic pH for some postmenopausal women with recurrent cystitis.

The antibacterial activity of prostatic secretions that protect men from bacterial colonization of the urethra and bladder decreases with aging. The use of catheterization or cystoscopy in evaluation or treatment for prostatic hyperplasia or carcinoma, strictures of the urethra, and neuropathic bladder may contribute to the higher incidence of UTIs in men. The incidence of bacteriuria also increases in men with confusion, dementia, or bowel or bladder incontinence. The most common cause of recurrent UTIs in older males is chronic bacterial prostatitis. Resection of the prostate gland may help reduce its incidence (see Chapter 46).

Chart 45-3 lists other factors that may contribute to UTI in older patients. Diligent hand hygiene, careful perineal care, and frequent toileting may decrease the incidence of UTIs.

The organisms responsible for UTIs in the institutionalized older adult may differ from those found in patients residing in the community; this is thought to result in part from the frequent use of antibiotic agents by patients in long-term care facilities. *E. coli* is the most common organism seen in older patients in the community or hospital. However, patients with indwelling catheters are more likely to be infected with organisms such as *Proteus, Klebsiella, Pseudomonas,* or *Staphylococcus.* Patients who have been previously treated with antibiotics may be

Chart 45-3

Factors That Contribute to Urinary Tract Infection in Older Adults

- Cognitive impairment
- Frequent use of antimicrobial agents
- High incidence of multiple chronic medical conditions
- Immunocompromise
- Immobility and incomplete emptying of bladder
- Obstructed flow of urine (e.g., urethral strictures, neoplasms, or a clogged indwelling catheter)

Adapted from Eliopoulos, C. (2018). Gerontological nursing (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

infected with *Enterococcus* species. Frequent reinfections are common in older adults.

Early symptoms of UTI in older adults include burning, urgency, and fever (Eliopoulos, 2018). Some patients develop incontinence and delirium with the onset of a UTI.

Antibiotics are prescribed when bacteriuria is present (Eliopoulos, 2018). Treatment regimens are generally the same as those for younger adults, although age-related changes in the intestinal absorption of medications and decreased kidney function and hepatic flow may necessitate alterations in the antimicrobial regimen. Kidney function must be monitored, and medication dosages should be altered accordingly. The nurse carefully monitors fluid intake and output. Increasing fluid intake is advisable, provided that the patient's cardiac status does not contraindicate this action (Eliopoulos, 2018).

Assessment and Diagnostic Findings

Results of various tests, such as bacterial colony counts, cellular studies, and urine cultures, help confirm the diagnosis of UTI. In an uncomplicated UTI, the strain of bacteria determines the antibiotic of choice (Grossman & Porth, 2014).

Urine Cultures

Urine cultures are useful for documenting a UTI and identifying the specific organism present. UTI is diagnosed by bacteria in the urine culture. A colony count greater than 100,000 CFU/mL of urine on a clean-catch midstream or catheterized specimen indicates infection (Fischbach & Dunning, 2015). However, UTI and subsequent sepsis have occurred with lower bacterial colony counts. The presence of any bacteria in specimens obtained by suprapubic needle aspiration of the urinary bladder, straight catheterization (insertion of a tube into the urinary bladder), or during surgery or cystoscopy is considered clinically significant (Fischbach & Dunning, 2015).

The following groups of patients should have urine cultures obtained when bacteriuria is present:

- All children
- All men (because of the likelihood of structural or functional abnormalities)
- Patients who have been recently hospitalized or who live in long-term care facilities
- Patients who have undergone recent instrumentation (including catheterization) of the urinary tract
- Patients with diabetes
- Patients with prolonged or persistent symptoms
- Patients with three or more UTIs in the previous year
- Women who are postmenopausal
- Women who are pregnant
- Women who are sexually active
- Women who have new sexual partners
- Women with a history of compromised immune function or renal problems

Cellular Studies

Microscopic hematuria is present in about half of patients with an acute UTI (see Chapter 43). Pyuria (white blood cells [WBCs] in the urine) occurs in all patients with UTI; however, it is not specific for bacterial infection. Pyuria can also be seen with kidney stones, interstitial nephritis, and renal tuberculosis.

Other Studies

A multiple-test dipstick often includes testing for WBCs, known as the leukocyte esterase test, and nitrite testing (Grossman & Porth, 2014). Tests for sexually transmitted infections may be performed because acute urethritis caused by sexually transmitted organisms (i.e., *Chlamydia trachomatis, Neisseria gonorrhoeae,* herpes simplex) or acute vaginitis infections (caused by *Trichomonas* or *Candida* species) may be responsible for symptoms similar to those of UTIs.

X-ray images, computed tomography (CT) scan, ultrasonography, and kidney scans are useful diagnostic tools. A CT scan may detect pyelonephritis or abscesses. Ultrasonography and kidney scans are extremely sensitive for detecting obstruction, abscesses, tumors, and cysts (Grossman & Porth, 2014).

Medical Management

Management of UTIs typically involves pharmacologic therapy and patient education. Various prescribed medication regimens are used to treat UTI.

Acute Pharmacologic Therapy

The ideal medication for treatment of UTI is an antibacterial agent that eradicates bacteria from the urinary tract with minimal effects on fecal and vaginal flora, thereby minimizing the incidence of vaginal yeast infections. The antibacterial agent should be affordable and should have few adverse effects and low resistance. Because the organism in initial, uncomplicated UTIs in women is most likely *E. coli* or other fecal flora, the agent should be effective against these organisms. Various treatment regimens have been successful in treating uncomplicated lower UTIs in women: single-dose administration, short-course (3-day) regimens, or 7-day regimens (Hopkins et al., 2014). The trend is toward a shortened course of antibiotic therapy for uncomplicated UTIs, because most cases are cured after 3 days of treatment. Medications commonly used to treat UTIs are listed in Table 45-1. Regardless of the regimen prescribed, the patient is instructed to take all doses prescribed, even if relief of symptoms occurs promptly. Longer medication courses are indicated for men, pregnant women, and women with pyelonephritis and other types of complicated UTIs. Hospitalization and intravenous (IV) antibiotics are occasionally necessary (Hopkins et al., 2014).

Long-Term Pharmacologic Therapy

Although brief pharmacologic treatment of UTIs for 3 days is usually adequate in women, infection recurs in about 20% of women treated for uncomplicated UTIs. Infections that recur within 2 weeks of therapy do so because organisms of the original offending strain remain. Relapses suggest that the source of bacteriuria may be the upper urinary tract or

TABLE 45-1 Examples of Medications Used to Treat Urinary Tract Infections and Pyelonephritis

Drug Classes	Generic (Brand) Name	Major Indications
Anti-infective, urinary tract Bactericidal	Nitrofurantoin (Macrodantin, Furadantin) Cephalexin (Keflex)	UTI Genitourinary infection
Cephalosporin	Cefadroxil (Duricef, Ultracef)	UTI
Fluoroquinolone	Ciprofloxacin (Cipro) Ofloxacin (Floxin) Norfloxacin (Noroxin) Gatifloxacin (Zymar)	UTI Pyelonephritis
Fluoroquinolone	Levofloxacin (Levaquin)	Uncomplicated UTI
Penicillin	Ampicillin (Principen, Omnipen) Amoxicillin (Amoxil)	UTI—not commonly used alone due to *Escherichia coli* resistance Pyelonephritis UTI—not commonly used alone due to *E. coli* resistance
Trimethoprim–sulfamethoxazole combination	Co-trimoxazole (Bactrim, Septra)	UTI Pyelonephritis
Urinary analgesic agent	Phenazopyridine (Pyridium)	For relief of burning, pain, and other symptoms associated with UTI

UTI, urinary tract infection.

Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer; Hopkins, L., McCroskey, D., Reeves, G., et al. (2014). Implementing a urinary tract infection clinical practice guideline in an ambulatory urgent care practice. The Nurse Practitioner, 39(4), 50–54.

that initial treatment was inadequate or given for too short a time. Recurrent infections in men are usually caused by persistence of the same organism; further evaluation and treatment are indicated (Hopkins et al., 2014).

If infection recurs after completing antimicrobial therapy, another short course (3 to 4 days) of full-dose antimicrobial therapy followed by a regular bedtime dose of an antimicrobial agent may be prescribed. If there is no recurrence, medication is taken every other night for 6 to 7 months. Long-term use of antimicrobial agents decreases the risk of reinfection and may be indicated in patients with recurrent infections.

If recurrence is caused by persistent bacteria from preceding infections, the cause (i.e., kidney stone, abscess), if known, must be treated. After treatment and sterilization of the urine, low-dose prophylactic therapy (trimethoprim with or without sulfamethoxazole) each night at bedtime may be prescribed (Hopkins et al., 2014).

Daily intake of cranberry juice can help prevent and control symptoms of UTI (Bass-Ware, Weed, Johnson, et al., 2014); (Hopkins et al., 2014). One group of researchers reported that daily consumption of cranberry juice over an 8-week period decreased symptoms (i.e., urgency, frequency, nocturia, dysuria, and pain) in women diagnosed with a UTI in an ambulatory setting (Bass-Ware, et al., 2014).

NURSING PROCESS

The Patient With a Lower Urinary Tract Infection

Nursing care of the patient with a lower UTI focuses on treating the underlying infection and preventing its recurrence.

Assessment

A history of pertinent signs and symptoms is obtained from the patient with a suspected UTI. The presence of pain, frequency, urgency, hesitancy, and changes in urine are assessed, documented, and reported. The patient's usual pattern of voiding is assessed to detect factors that may predispose him or her to UTI. Infrequent emptying of the bladder, the association of symptoms of UTI with sexual intercourse, contraceptive practices, and personal hygiene are assessed. The patient's knowledge about prescribed antimicrobial medications and preventive health care measures is also assessed. In addition, the urine is assessed for volume, color, concentration, cloudiness, and odor—all of which are altered by bacteria in the urinary tract. Patients need to be asked specifically about the use of complementary and alternative therapies. Researchers in one study reported that women with interstitial cystitis (inflammation of the bladder wall) used both complementary and conventional therapies. The most common complementary therapies reported included diet, biofeedback, dietary supplements, meditation, yoga, and massage (Anderson & Zinkgraf, 2013).

Diagnosis

Nursing Diagnoses

Based on the assessment data, nursing diagnoses may include the following:

- Acute pain related to infection within the urinary tract
- Deficient knowledge about factors predisposing the patient to infection and recurrence, detection and prevention of recurrence, and pharmacologic therapy

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Sepsis (urosepsis)
- Acute kidney injury and/or chronic kidney disease may occur as the long-term result of either an extensive infective or inflammatory process

Planning and Goals

Major goals for the patient may include relief of pain and discomfort, increased knowledge of preventive measures and treatment modalities, and absence of complications.

Nursing Interventions

Relieving Pain

The pain associated with a UTI is quickly relieved once effective antimicrobial therapy is initiated. Antispasmodic agents may also be useful in relieving bladder irritability and pain. Analgesic agents and the application of heat to the perineum help relieve pain and spasm. The patient is encouraged to drink liberal amounts of fluids (water is the best choice) to promote renal blood flow and to flush the bacteria from the urinary tract. Urinary tract irritants (e.g., coffee, tea, citrus, spices, colas, alcohol) should be avoided. Frequent voiding (every 2 to 3 hours) is encouraged to empty the bladder completely, because doing so can lower urine bacterial counts, reduce urinary stasis, and prevent reinfection (Bass-Ware, et al., 2014); (Hopkins et al., 2014).

Monitoring and Managing Potential Complications

Early recognition of UTI and prompt treatment are essential to prevent recurrent infection and the possibility of complications, such as kidney disease, sepsis (urosepsis), strictures, and obstructions. The goal of treatment is to prevent infection from progressing and causing permanent kidney damage and injury. Thus, the patient must be educated to recognize early signs and symptoms, to test for bacteriuria, and to initiate treatment as prescribed. Appropriate antimicrobial therapy, liberal fluid intake, frequent voiding, and hygienic measures are commonly prescribed for managing UTIs. The patient is instructed to notify the primary provider if fatigue, nausea, vomiting, fever, or pruritus occurs. Periodic monitoring of renal function and evaluation for strictures, obstructions, or stones may be indicated for patients with recurrent UTIs.

Patients with UTIs are at increased risk for gram-negative sepsis. For each day a urinary catheter is in place, the risk of developing catheter-associated urinary tract infection (CAUTI) increases. The risk of sepsis in patients with a urinary catheter is about 15% (Booker, 2015). CAUTIs should be avoided as they result in unpleasant symptoms, additional pharmacologic therapy, serious complications, and delayed discharge (Booker, 2015); (Carter, Reitmeier, & Goodloe, 2014).

If an indwelling catheter is necessary, the following specific nursing interventions are initiated to prevent infection and urosepsis:

- Using strict aseptic technique during insertion of the smallest catheter possible
- Securing the catheter to prevent movement
- Frequently inspecting urine color, odor, and consistency
- Performing meticulous daily perineal care with soap and water
- Maintaining a closed system
- Following the manufacturer's instructions when using the catheter port to obtain urine specimens

Careful assessment of vital signs and level of consciousness may alert the nurse to kidney involvement or impending sepsis. Positive blood cultures and elevated WBC counts must be reported immediately. At the same time, appropriate antibiotic therapy and increased fluid intake are prescribed (IV antibiotic therapy and fluids may be required). Aggressive early treatment is the key to reducing the mortality rate associated with CAUTI especially in older patients, those with anemia, and those with elevated blood sugar levels (Hagerty et al., 2015). See Chart 45-4 for more information on risk factors for CAUTIs.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care. In helping patients learn about and prevent or manage a recurrent UTI, the nurse implements education that meets the patient's needs. Health-related behaviors that help prevent recurrent UTIs include practicing careful personal hygiene, increasing fluid intake to promote voiding and dilution of urine, urinating regularly and more frequently, and adhering to the therapeutic regimen. For a detailed discussion of patient education, see Chart 45-5.

Evaluation

Expected patient outcomes may include:

1. Experiences relief of pain
   a. Reports absence of pain, urgency, frequency, nocturia, or hesitancy on voiding

Chart 45-4 NURSING RESEARCH PROFILE

Risk Factors for Catheter-Associated Urinary Tract Infections

Hagerty, T., Kertesz, L., Schmidt, J. M., et al. (2015). Risk factors for catheter associated urinary tract infections in critically ill patients with subarachnoid hemorrhage. Journal of Neuroscience Nursing, 47(1), 51–54.

Purpose

The use of indwelling urinary catheters can lead to complications, most importantly catheter-associated urinary tract infections (CAUTI). These infections are the most common health care–associated infection in the United States. The purpose of this study was to assess the prevalence of and risk factors for CAUTIs among patients with subarachnoid hemorrhage (SAH) in one neurologic intensive care unit.

Design

This quantitative study used a retrospective design and included 242 patients with SAH admitted between 2005 and 2012 for whom data had been included in an existing data set. Logistic regression was used to identify predictors of CAUTI.

Findings

Catheterized adult patients (n = 242) with SAH over the 8-year period were included in the analysis. The rate of CAUTIs was 21%, or 6 times higher than the reported national average. Variables statistically significantly associated with CAUTI were older age (odds ratio [OR] = 1.06, 95% confidence interval [CI] [1.01, 1.11]), increased blood sugar levels (OR = 13.0, 95% CI [1.28, 107.4]), and anemia requiring transfusion (OR = 3.78, 95% CI [0.977, 14.67]).

Nursing Implications

Nurses should know that the high rates of CAUTI in this study were likely associated with prolonged catheterization. These findings indicate that nurses should carefully assess the need for catheterization and have increased vigilance regarding urinary catheter care in patients admitted with an SAH. Particular attention should be paid to patients who are older, those with anemia requiring transfusion, and those with elevated blood glucose levels due to their increased risk of CAUTI.

Chart 45-5 PATIENT EDUCATION

Preventing Recurrent Urinary Tract Infections

The nurse instructs the patient on the following basic information:

Hygiene

- Shower rather than bathe in the tub because bacteria in the bathwater may enter the urethra.
- Clean the perineum and urethral meatus from front to back after each bowel movement. This will help reduce concentrations of pathogens at the urethral opening and, in women, the vaginal opening.

Fluid Intake

- Drink liberal amounts of fluids daily to flush out bacteria. It may be helpful to include at least one glass of cranberry juice per day.
- Avoid coffee, tea, colas, alcohol, and other fluids that are urinary tract irritants.

Voiding Habits

Void every 2–3 hours during the day, and completely empty the bladder. This prevents overdistention of the bladder and compromised blood supply to the bladder wall. Both predispose the patient to urinary tract infection. Precautions expressly for women include voiding immediately after sexual intercourse.

Interventions

- Take medication *exactly* as prescribed. Special timing of administration may be required.
- Keep in mind that if bacteria continue to appear in the urine, long-term antimicrobial therapy may be required to prevent colonization of the periurethral area and recurrence of infection.
- For recurrent infection, consider acidification of the urine through ascorbic acid (vitamin C), 1000 mg daily, or daily consumption of cranberry juice.
- To decrease recurrences, consider *Lactobacillus* probiotics use in oral or vaginal form.
- If prescribed, test urine for presence of bacteria following manufacturer's and health care provider's instructions.
- Notify the primary provider if fever occurs or if signs and symptoms persist.
- Consult the primary provider regularly for follow-up.

Adapted from Bass-Ware, A., Weed, D., Johnson. T., et al. (2014). Evaluation of the effect of cranberry juice on symptoms associated with a urinary tract infection. Urologic Nursing, 34(3), 121–127; Chisholm, A. H. (2015). Probiotics in preventing recurrent urinary tract infections in women: A literature review. Urologic Nursing, 35(1), 18–21, 29.

   b. Takes analgesic, antispasmodic, and antibiotic agents as prescribed
2. Explains UTIs and their treatment
   a. Demonstrates knowledge of preventive measures and prescribed treatments
   b. Drinks 8 to 10 glasses of fluids daily
   c. Voids every 2 to 3 hours
   d. Produces urine that is clear and odorless
3. Experiences no complications
   a. Reports no symptoms of infection (fever, frequency)
   b. Has normal kidney function, negative urine and blood cultures
   c. Exhibits normal vital signs and temperature; no signs or symptoms of sepsis (urosepsis)
   d. Maintains adequate urine output more than 0.5 mL/kg/hr

Upper Urinary Tract Infections

Pyelonephritis is a bacterial infection of the renal pelvis, tubules, and interstitial tissue of one or both kidneys. Causes involve either the upward spread of bacteria from the bladder or spread from systemic sources reaching the kidney via the bloodstream. Pathogenic bacteria from a bladder infection can ascend into the kidney, resulting in pyelonephritis. An incompetent ureterovesical valve or obstruction occurring in the urinary tract increases the susceptibility of the kidneys to infection (see Fig. 45-1), because static urine provides a good medium for bacterial growth. Bladder or prostate tumors, strictures, benign prostatic hyperplasia, and urinary stones are some potential causes of obstruction that can lead to infections. Systemic infections (such as tuberculosis) can spread to the kidneys and result in abscesses.

Pyelonephritis may be acute or chronic. Acute pyelonephritis usually leads to enlargement of the kidneys with interstitial infiltrations of inflammatory cells (Grossman & Porth, 2014). Abscesses may be noted on or within the renal capsule and at the corticomedullary junction. Eventually, atrophy and destruction of tubules and the glomeruli may result. When pyelonephritis becomes chronic, the kidneys become scarred, contracted, and nonfunctioning. Chronic pyelonephritis is a cause of chronic kidney disease that can result in the need for renal replacement therapies such as transplantation or dialysis.

Acute Pyelonephritis

Clinical Manifestations

The patient with acute pyelonephritis has chills, fever, leukocytosis, bacteriuria, and pyuria. Low back pain, flank pain, nausea and vomiting, headache, malaise, and painful urination are common findings. Physical examination reveals pain and tenderness in the area of the costovertebral angle (see Fig. 43-6 in Chapter 43). In addition, symptoms of lower urinary tract involvement, such as urgency and frequency, are common.

Assessment and Diagnostic Findings

An ultrasound study or a CT scan may be performed to locate an obstruction in the urinary tract. Relief of obstruction is essential to prevent complications and eventual kidney damage. An IV pyelogram may be indicated with pyelonephritis if functional and structural renal abnormalities are suspected (Fischbach & Dunning, 2015). Radionuclide imaging with gallium citrate and indium-111 (^{111}In)–labeled WBCs may be useful to identify sites of infection that may not be visualized on CT scan or ultrasound. Urine culture and sensitivity tests are performed to determine the causative organism so that appropriate antimicrobial agents can be prescribed (Fischbach & Dunning, 2015).

Medical Management

Patients with acute uncomplicated pyelonephritis are most often treated on an outpatient basis if they are not exhibiting

acute symptoms of sepsis, dehydration, nausea, or vomiting. In addition, they must be responsible and reliable to ensure that all medications will be taken as prescribed. For outpatients, a 2-week course of antibiotic agents is recommended because renal parenchymal disease is more difficult to eradicate than mucosal bladder infections. Commonly prescribed agents include many of the same medications prescribed for the treatment of UTIs (see Table 45-1).

Following acute pyelonephritis treatment, the patient may develop a chronic or recurring symptomless infection persisting for months or years. After the initial antibiotic regimen, the patient may need antibiotic therapy for up to 6 weeks if a relapse occurs. A follow-up urine culture is obtained 2 weeks after completion of antibiotic therapy to document clearing of the infection.

Hydration with oral or parenteral fluids is essential in all patients with UTIs when there is adequate kidney function. Hydration helps facilitate "flushing" of the urinary tract and reduces pain and discomfort.

Chronic Pyelonephritis

Repeated bouts of acute pyelonephritis may lead to chronic pyelonephritis.

Clinical Manifestations

The patient with chronic pyelonephritis usually has no symptoms of infection unless an acute exacerbation occurs. Noticeable signs and symptoms may include fatigue, headache, poor appetite, polyuria, excessive thirst, and weight loss. Persistent and recurring infection may produce progressive scarring of the kidney, resulting in chronic kidney disease (see Chapter 44).

Assessment and Diagnostic Findings

The extent of the disease is assessed by an IV urogram and measurements of creatinine clearance, blood urea nitrogen, and creatinine levels (Fischbach & Dunning, 2015).

Complications

Complications of chronic pyelonephritis include end-stage kidney disease (from progressive loss of nephrons secondary to chronic inflammation and scarring), hypertension, and formation of kidney stones (from chronic infection with urea-splitting organisms).

Medical Management

Bacteria, if detected in the urine, are eradicated if possible. Long-term use of prophylactic antimicrobial therapy may help limit recurrence of infections and kidney scarring. Impaired kidney function alters the excretion of antimicrobial agents and necessitates careful monitoring of kidney function, especially if the medications are potentially toxic to the kidneys.

Nursing Management

The patient may require hospitalization or may be treated as an outpatient. When the patient requires hospitalization, fluid intake and output are carefully measured and recorded. Unless contraindicated, 3 to 4 L of fluids per day is encouraged to dilute the urine, decrease burning on urination, and prevent dehydration. The nurse assesses the patient's temperature every 4 hours and administers antipyretic and antibiotic agents as prescribed.

Patient education focuses on prevention of further infection by consuming adequate fluids, emptying the bladder regularly, and performing recommended perineal hygiene. The importance of taking antimicrobial medications exactly as prescribed is stressed, as is the need for keeping follow-up appointments.

ADULT VOIDING DYSFUNCTION

Both neurogenic and nonneurogenic disorders can cause adult voiding dysfunction (see Table 45-2). The micturition (voiding or urination) process involves several highly coordinated neurologic responses that mediate bladder function. A functional urinary system allows for appropriate bladder filling and complete bladder emptying (see Chapter 43). If voiding dysfunction goes undetected and untreated, the upper urinary system may be compromised. Chronic incomplete bladder emptying from poor detrusor pressure results in recurrent bladder infection. Incomplete bladder emptying due to bladder outlet obstruction (such as benign prostatic hyperplasia), causing high-pressure detrusor contractions, can result in hydronephrosis from the high detrusor pressure that radiates up the ureters to the renal pelvis.

Urinary Incontinence

Approximately 22% of women are estimated to have urinary incontinence (involuntary or uncontrolled loss of urine from the bladder), with most of them experiencing stress incontinence (Singh, Agarwal & Shankwhar, 2013). Despite widespread media coverage, urinary incontinence remains underdiagnosed and underreported. Patients may be too embarrassed to seek help, causing them to ignore or conceal symptoms. Many patients use absorbent pads or other devices without having their condition properly diagnosed and treated (Day, Leahy-Warren, Loughran, et al., 2014). Health care providers must be alert to subtle cues of urinary incontinence and stay informed about current management strategies.

The costs of care for patients with urinary incontinence include the expenses of absorbent products, medications, and surgical or nonsurgical treatment modalities, as well as psychosocial costs (i.e., embarrassment, loss of self-esteem, and social isolation) (Day et al., 2014); (McCooty & Latthe, 2014).

Although urinary incontinence is commonly regarded as a condition that occurs in older multiparous women, it can occur in young nulliparous women, especially during vigorous high-impact activity. Age, gender, and number of vaginal deliveries are established risk factors that explain, in part, the increased incidence in women (see Chart 45-6). Men can have urinary incontinence, especially those with certain comorbid conditions. One group of researchers, for example, reported that 40% of men with Parkinson disease reported urinary incontinence (Robinson, Bradway, Bunting-Perry, et al., 2013). Urinary incontinence is a symptom of many possible disorders.

Types

There are many types of urinary incontinence, including the following:

Stress incontinence is the involuntary loss of urine through an intact urethra as a result of sneezing, coughing, or changing position (Miller, 2015); (Weber & Kelley, 2014). It predominantly affects women who have had vaginal deliveries and is thought to be the result of decreasing ligament and pelvic floor support of the urethra and decreasing or absent estrogen levels within the urethral walls and bladder base. In men, stress incontinence

TABLE 45-2 Conditions Causing Adult Voiding Dysfunction

Condition	Voiding Dysfunction	Treatment
Neurogenic Disorders		
Cerebellar ataxia	Incontinence or dyssynergia	Timed voiding; anticholinergic agents
Stroke	Retention or incontinence	Anticholinergic agents; bladder retraining
Dementia	Incontinence	Prompted voiding; anticholinergic agents
Diabetes	Incontinence and/or incomplete bladder emptying	Timed voiding; EMG/biofeedback; pelvic floor nerve stimulation; anticholinergic/antispasmodic agents; well-controlled blood glucose levels
Multiple sclerosis	Incontinence or incomplete bladder emptying	Timed voiding; EMG/biofeedback to learn pelvic muscle exercises and urge inhibition; pelvic floor nerve stimulation; antispasmodic agents
Parkinson disease	Incontinence	Anticholinergic/antispasmodic agents
Spinal Cord Dysfunction		
Acute injury	Urinary retention	Indwelling catheter
Degenerative disease	Incontinence and/or incomplete bladder emptying	EMG/biofeedback; pelvic floor nerve stimulation; anticholinergic agents
Nonneurogenic Disorder		
"Bashful bladder"	Inability to initiate voiding in public bathrooms	Relaxation therapy; EMG/biofeedback
Overactive bladder	Urgency, frequency, and/or urge incontinence	EMG/biofeedback; pelvic floor nerve stimulation; bladder drill (see Chart 45-8); anticholinergic agents
Post general surgery	Acute urine retention	Catheterization
Post prostatectomy	Incontinence	*Mild*: Biofeedback; bladder drill (see Chart 45-8); pelvic floor nerve stimulation *Moderate/severe*: *Surgery*—artificial sphincter
Stress incontinence	Incontinence with cough, laugh, sneeze, position change	*Mild*: Biofeedback; bladder drill (see Chart 45-8); periurethral bulking with collagen *Moderate/severe*: Surgery

EMG, electromyogram.

Adapted from Bader, M. K., Littlejohns, L. R., & Olson, D. M. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Chart 45-6 RISK FACTORS

Urinary Incontinence

- Age-related changes in the urinary tract
- Caregiver or toilet unavailable
- Cognitive disturbances—dementia, Parkinson disease
- Diabetes
- Genitourinary surgery
- High-impact exercise
- Immobility
- Incompetent urethra due to trauma or sphincter relaxation
- Medications—diuretic, sedative, hypnotic, and opioid agents
- Menopause
- Morbid obesity
- Pelvic muscle weakness
- Pregnancy—vaginal delivery, episiotomy
- Stroke

Adapted from Robinson, J. P., Bradway. C. W., Bunting-Perry, L., et al. (2013). Lower urinary tract symptoms in men with Parkinson's disease. Journal of Neuroscience Nursing, 45(6). 382–392.

is often experienced after a radical prostatectomy for prostate cancer because of the loss of urethral compression that the prostate had supplied before the surgery, and possibly bladder wall irritability.

Urge incontinence is the involuntary loss of urine associated with a strong urge to void that cannot be suppressed (Miller, 2015); (Weber & Kelley, 2014). The patient is aware of the need to void but is unable to reach a toilet in time. An uninhibited detrusor contraction is the precipitating factor. This can occur in a patient with neurologic dysfunction that impairs inhibition of bladder contraction or in a patient without overt neurologic dysfunction.

Functional incontinence refers to those instances in which lower urinary tract function is intact but other factors, such as severe cognitive impairment (e.g., Alzheimer dementia), make it difficult for the patient to identify the need to void or physical impairments make it difficult or impossible for the patient to reach the toilet in time for voiding (Miller, 2015).

Iatrogenic incontinence refers to the involuntary loss of urine due to extrinsic medical factors, predominantly medications. One such example is the use of alpha-adrenergic agents to decrease blood pressure. In some people with an intact urinary system, these agents adversely affect the alpha receptors responsible for bladder neck closing pressure; the bladder neck relaxes to the point of incontinence with a minimal increase in intra-abdominal pressure, thus mimicking stress incontinence. As soon as the medication is discontinued, the apparent incontinence resolves.

Mixed urinary incontinence, which encompasses several types of urinary incontinence, is involuntary leakage associated with urgency and also with exertion, effort, sneezing, or coughing (Miller, 2015).

Only with appropriate recognition of the problem, assessment, and referral for diagnostic evaluation and treatment can the outcome of incontinence be determined. All people with incontinence should be considered for evaluation and treatment.

Gerontologic Considerations

Although urinary incontinence is not a normal consequence of aging, age-related changes in the urinary tract do predispose the older person to incontinence. However, if nurses and other health care providers accept incontinence as an inevitable part of illness or aging or consider it irreversible and untreatable, it cannot be treated successfully. Collaborative, interdisciplinary efforts are essential in assessing and effectively treating urinary incontinence.

Urinary incontinence can decrease an older person's ability to maintain an independent lifestyle, which increases dependence on caregivers and may lead to institutionalization. Between 25% and 45% of older women have urinary incontinence (Day et al., 2014).

Many older adults experience transient episodes of incontinence that tend to be abrupt in onset. When this occurs, the nurse should question the patient, as well as the family if possible, about the onset of symptoms and any signs or symptoms of a change in other organ systems. Acute UTI, infection elsewhere in the body, constipation, decreased fluid intake, and a change in a chronic disease pattern, such as elevated blood glucose levels in patients with diabetes or decreased estrogen levels in menopausal women, can provoke the onset of urinary incontinence. If the cause is identified and modified or eliminated early at the onset of incontinence, the incontinence itself may be eliminated. Although the bladder of the older person is more vulnerable to altered detrusor activity, age alone is not a risk factor for urinary incontinence (Miller, 2015).

Decreased bladder muscle tone is a normal age-related change found in older adults. This leads to decreased bladder capacity, increased residual urine (urine remaining in the bladder after voiding), and an increase in urgency.

Many medications affect urinary continence in addition to causing other unwanted or unexpected effects (Miller, 2015). All medications need to be assessed for potential interactions.

Assessment and Diagnostic Findings

Once incontinence is recognized, a thorough history is necessary. This includes a detailed description of the problem and a history of medication use. The patient's voiding history, a diary of fluid intake and output, and bedside tests (e.g., residual urine, stress maneuvers) may be used to help determine the type of urinary incontinence involved. Extensive urodynamic tests may be performed (see Chapter 43). Urinalysis and urine culture are performed to identify infection.

Urinary incontinence may be transient or reversible if the underlying cause is successfully treated and the voiding pattern reverts to normal. Chart 45-7 provides causes of transient incontinence.

Medical Management

Management depends on the type of urinary incontinence and its causes. Management of urinary incontinence may be behavioral, pharmacologic, or surgical.

Behavioral Therapy

Behavioral therapies are the first choice to decrease or eliminate urinary incontinence (see Chart 45-8). In using these techniques, health care professionals help patients avoid potential adverse effects of pharmacologic or surgical interventions. Pelvic floor muscle exercises (sometimes referred to as Kegel exercises) represent the cornerstone of behavioral intervention for addressing symptoms of stress, urge, and mixed incontinence (Miller, 2015); (Weber & Kelley, 2014). Other behavioral treatments include the use of a voiding diary, biofeedback, verbal instruction (prompted voiding), and physical therapy (Day et al., 2014); (McCooty & Latthe, 2014).

Chart 45-7

Causes of Transient Incontinence

- Atrophic vaginitis, urethritis, prostatitis
- Delirium or confusion
- Excessive urine production (increased intake, diabetes, diabetic ketoacidosis)
- Limited or restricted activity
- Pharmacologic agents (anticholinergic agents, sedatives, alcohol, analgesic agents, diuretics, muscle relaxants, adrenergic agents)
- Psychological factors (depression, regression)
- Stool impaction or constipation
- Urinary tract infections (UTI)

Pharmacologic Therapy

Pharmacologic therapy works best when used as an adjunct to behavioral interventions. Anticholinergic agents inhibit bladder contraction and are considered first-line medications for urge incontinence. A tricyclic antidepressant medication (e.g., amitriptyline [Elavil]) can also decrease bladder contractions as well as increase bladder neck resistance (Comerford, 2015). Pseudoephedrine sulfate (Sudafed), which acts on alpha-adrenergic receptors, causing urinary retention, may be used to treat stress incontinence; it needs to be used with caution in men with prostatic hyperplasia and patients with hypertension.

Surgical Management

Surgical correction may be indicated in patients who have not achieved continence using behavioral and pharmacologic therapy. Surgical options vary according to the underlying anatomy and the physiologic problem. Most procedures involve lifting and stabilizing the bladder or urethra to restore the normal urethrovesical angle or to lengthen the urethra.

Women with stress incontinence may undergo an anterior vaginal repair, retropubic suspension, or needle suspension to reposition the urethra. Procedures to compress the urethra and increase resistance to urine flow include sling procedures and placement of periurethral bulking agents such as artificial collagen.

Periurethral bulking is a semipermanent procedure in which small amounts of artificial collagen are placed within the walls of the urethra to enhance the closing pressure of the urethra (Matsuoka, Locali, Pacetta, et al., 2016). This procedure takes only 10 to 20 minutes and may be performed under local anesthesia or moderate sedation. A cystoscope is inserted into the urethra. An instrument is inserted through the cystoscope to deliver a small amount of collagen into the urethral wall at locations selected by the urologist. The patient is usually discharged home after voiding. There are no restrictions following the procedure, although occasionally more than one collagen bulking session may be necessary if the initial procedure did not halt stress incontinence. Collagen placement anywhere in the body is considered semipermanent because its durability averages between 12 and 24 months, until the body absorbs the material. Periurethral bulking with collagen is a relatively safe alternative to surgery (Matsuoka et al., 2016). It is also an option for people who are seeking help with stress incontinence who prefer to avoid surgery and who do not have access to behavioral therapies.

An artificial urinary sphincter can be used to close the urethra and promote continence. Two types of artificial sphincters are a periurethral cuff and a cuff inflation pump.

Men with overflow and stress incontinence may undergo a transurethral resection to relieve symptoms of prostatic enlargement. An artificial sphincter can be used after prostatic surgery for sphincter incompetence (see Fig. 45-2). After surgery, periurethral bulking agents can be injected into the periurethral area to increase compression of the urethra (Matsuoka et al., 2016).

Chart 45-8 HEALTH PROMOTION

Interventions for Urinary Incontinence

Behavioral strategies are largely carried out, coordinated, and monitored by the nurse. These interventions may or may not be augmented by the use of medications.

Fluid Management

An adequate daily fluid intake of approximately 50–60 oz (1500–1600 mL), taken as small increments between breakfast and the evening meal, helps to reduce urinary urgency related to concentrated urine production, decreases the risk of urinary tract infection, and maintains bowel functioning. (Constipation, resulting from inadequate daily fluid intake, can increase urinary urgency and urine retention.) The best fluid is water, although some suggest it may be helpful to include at least one glass of cranberry juice per day. Fluids containing caffeine, carbonation, alcohol, or artificial sweetener should be avoided because they irritate the bladder wall, thus resulting in urinary urgency. Some patients who have heart failure or end-stage kidney disease need to discuss their daily fluid limit with their primary provider.

Standardized Voiding Frequency

After establishing a patient's natural voiding and urinary incontinence tendencies, voiding on a schedule can be very effective in those with and without cognitive impairment, although patients with cognitive impairment may require assistance with this technique from nursing personnel or family members. The object is to purposely empty the bladder before the bladder reaches the critical volume that would cause an urge or stress incontinence episode. This approach involves the following:

- **Timed voiding** involves establishing a set voiding frequency (such as every 2 hours if incontinent episodes tend to occur 2 or more hours after voiding). The individual chooses to "void by the clock" at the given interval while awake rather than wait until a voiding urge occurs.
- **Prompted voiding** is timed voiding that is carried out by staff or family members when the individual has cognitive difficulties that make it difficult to remember to void at set intervals. The caregiver checks the patient to assess if he or she has remained dry and, if so, assists the patient to use the bathroom while providing positive reinforcement for remaining dry.
- **Habit retraining** is timed voiding at an interval that is more frequent than the individual would usually choose. This technique helps to restore the sensation of the need to void in individuals who are experiencing diminished sensation of bladder filling due to various medical conditions such as a stroke.
- **Bladder retraining**, also known as "bladder drill," incorporates a timed voiding schedule and urinary urge inhibition exercises to inhibit voiding, or leaking urine, in an attempt to remain dry for a set time. When the first timing interval is easily reached on a consistent basis without urinary urgency or incontinence, a new voiding interval, usually 10–15 minutes beyond the last, is established. Again, the individual practices urge inhibition exercises to delay voiding or avoid incontinence until the next preset interval arrives. When an acceptable voiding interval is reached, the patient continues that timed voiding sequence throughout the day.

Pelvic Muscle Exercise

Also known as Kegel exercises, pelvic muscle exercise (PME) aims to strengthen the voluntary muscles that assist in bladder and bowel continence in both men and women. Research shows that written or verbal instruction alone is usually inadequate to educate an individual about how to identify and strengthen the pelvic floor for sufficient bladder and bowel control. Biofeedback-assisted PME uses either electromyography or manometry to help the individual identify the pelvic muscles as they attempt to learn which muscle group is involved when performing PME. The biofeedback method also allows assessment of the strength of this muscle area.

PME involves gently tightening the same muscles used to stop flatus or the stream of urine for 5–10-second increments, followed by 10-second resting phases. To be effective, these exercises need to be performed 2 or 3 times a day for at least 6 weeks. Depending on the strength of the pelvic musculature when initially evaluated, anywhere from 10–30 repetitions of PME are prescribed at each session. Older patients may need to exercise for an even longer time to strengthen the pelvic floor muscles. Pelvic muscle exercises are helpful for women with stress, urge, or mixed incontinence and for men who have undergone prostate surgery.

Vaginal Cone Retention Exercises

Vaginal cone retention exercises are an adjunct to the Kegel exercises. Vaginal cones of varying weight are inserted intravaginally twice a day. The patient tries to retain the cone for 15 minutes by contracting the pelvic muscles.

Transvaginal or Transrectal Electrical Stimulation

Commonly used to treat urinary incontinence, electrical stimulation is known to elicit a passive contraction of the pelvic floor musculature, thus re-educating these muscles to provide enhanced levels of continence. This modality is often used with biofeedback-assisted pelvic muscle exercise training and voiding schedules. At high frequencies, it is effective for stress incontinence. At low frequencies, electrical stimulation can also relieve symptoms of urinary urgency, frequency, and urge incontinence. Intermediate ranges are used for mixed incontinence.

Neuromodulation

Neuromodulation via transvaginal or transrectal nerve stimulation of the pelvic floor inhibits detrusor overactivity and hypersensory bladder signals and strengthens weak sphincter muscles.

Adapted from Bader, M. K., Littlejohns, L. R., & Olson, D. M. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses; Bass-Ware, A., Weed, D., Johnson. T., et al. (2014). Evaluation of the effect of cranberry juice on symptoms associated with a urinary tract infection. Urologic Nursing, 34(3), 121–127; Chisholm, A. H. (2015). Probiotics in preventing recurrent urinary tract infections in women: A literature review. Urologic Nursing, 35(1), 18–21, 29.

Nursing Management

Nursing management is based on the premise that incontinence is not inevitable with illness or aging and that it is often reversible and treatable. The nursing interventions are determined in part by the type of treatment that is undertaken. For behavioral therapy to be effective, the nurse must provide support and encouragement, because it is easy for the patient to become discouraged if therapy does not quickly improve the level of continence. Patient education is important and should be provided verbally and in writing (see Chart 45-9). The patient should be educated to develop and use a log or diary to record timing of pelvic floor muscle exercises, frequency of voiding, any changes in bladder function, and any episodes of incontinence (Miller, 2015).

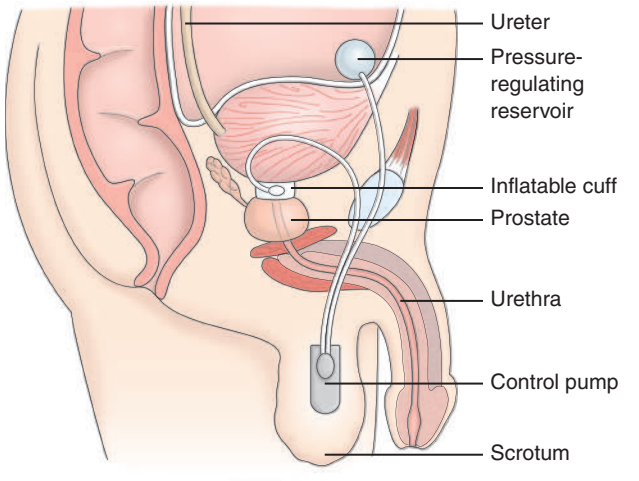


Figure 45-2 • Male artificial urinary sphincter. An inflatable cuff is inserted surgically around the urethra or neck of the bladder. To empty the bladder, the cuff is deflated by squeezing the control pump located in the scrotum.

Chart 45-9 PATIENT EDUCATION

Strategies for Promoting Urinary Continence

The nurse instructs the patient to:

- Avoid bladder irritants, such as caffeine, alcohol, and aspartame (NutraSweet).
- Avoid taking diuretic agents after 4 PM.
- Increase awareness of the amount and timing of all fluid intake.
- Perform all pelvic floor muscle exercises as prescribed, every day.
- Stop smoking (smokers usually cough frequently, which increases incontinence).
- Take steps to avoid constipation: Drink adequate fluids, eat a well-balanced diet high in fiber, exercise regularly, and take stool softeners if recommended.
- Void regularly, 5–8 times a day (about every 2–3 hours):
  - First thing in the morning
  - Before each meal
  - Before retiring to bed
  - Once during the night if necessary

If pharmacologic treatment is used, the patient and family are educated about its purpose. Patients with mixed incontinence must be informed that anticholinergic and antispasmodic agents can help decrease urinary urgency and frequency and urge incontinence but do not decrease the urinary incontinence related to stress incontinence. If surgical correction is undertaken, the procedure and its desired outcomes are described to the patient and family. Follow-up contact with the patient enables the nurse to answer the patient's questions and to provide reinforcement and encouragement.

Urinary Retention

Urinary retention is the inability to empty the bladder completely during attempts to void. Chronic urine retention often leads to overflow incontinence (involuntary urine loss associated with overdistention of the bladder). Residual urine is urine that remains in the bladder after voiding. In a healthy adult younger than 60 years, complete bladder emptying should occur with each voiding. In adults older than 60 years, 50 to 100 mL of residual urine may remain after each voiding because of the decreased contractility of the detrusor muscle.

Urinary retention can occur postoperatively in any patient, particularly if the surgery affected the perineal or anal regions and resulted in reflex spasm of the sphincters. General anesthesia reduces bladder muscle innervation and suppresses the urge to void, impeding bladder emptying.

Pathophysiology

Urinary retention may result from diabetes, prostatic enlargement, urethral pathology (infection, tumor, calculus), trauma (pelvic injuries), pregnancy, or neurologic disorders (e.g., stroke, spinal cord injury, multiple sclerosis, or Parkinson disease). Some medications cause urinary retention either by inhibiting bladder contractility or by increasing bladder outlet resistance (Comerford, 2015).

Assessment and Diagnostic Findings

The assessment of a patient for urinary retention is multifaceted because the signs and symptoms are challenging to detect. The following questions serve as a guide in assessment:

- What was the time of the last voiding, and how much urine was voided?
- Is the patient voiding small amounts of urine frequently?
- Is the patient dribbling urine?
- Does the patient complain of pain or discomfort in the lower abdomen? (Discomfort may be relatively mild if the bladder distends slowly.)
- Is the pelvic area rounded and swollen (could indicate urine retention and a distended bladder)?
- Does percussion of the suprapubic region elicit dullness (possibly indicating urine retention and a distended bladder)?
- Are other indicators of urinary retention present, such as restlessness and agitation?
- Does a postvoid bladder ultrasound test reveal residual urine?

The patient may verbalize an awareness of bladder fullness and a sensation of incomplete bladder emptying. Signs and symptoms of UTI (hematuria, urgency, frequency, and nocturia) may be present. A series of urodynamic studies (described in Chapter 43) may be performed to identify the type of bladder dysfunction and to aid in determining appropriate treatment. A voiding diary can be used to provide a written record of the amount of urine voided and the frequency of voiding. Postvoid residual urine may be assessed by using either straight catheterization or an ultrasound bladder scanner and is considered diagnostic of urinary retention. Normally, residual urine amounts to no more than 50 mL in the middle-aged adult and less than 50 to 100 mL in the older adult (Weber & Kelley, 2014).

Complications

The retention of urine can lead to chronic infections that if unresolved predispose the patient to renal calculi (urolithiasis or nephrolithiasis), pyelonephritis, sepsis, or hydronephrosis. In addition, urine leakage can lead to perineal skin breakdown, especially if regular hygiene measures are neglected.

Nursing Management

Strategies are instituted to prevent overdistention of the bladder and to treat infection or correct obstruction. However, many complications can be prevented with careful assessment and

appropriate nursing interventions. The nurse explains to the patient why normal voiding is not occurring and monitors urine output closely. The nurse also provides reassurance about the temporary nature of retention and successful management strategies.

Promoting Urinary Elimination

Nursing measures to encourage normal voiding patterns include providing privacy, ensuring an environment and body position conducive to voiding, and assisting the patient with the use of the bathroom or bedside commode, rather than a bedpan, to provide a more natural setting for voiding. If his condition allows, the male patient may stand beside the bed to use the urinal; most men find this position more comfortable and natural.

Additional measures include applying warmth to relax the sphincters (i.e., sitz baths, warm compresses to the perineum, showers), giving the patient hot caffeine free beverage and offering encouragement and reassurance. Simple trigger techniques, such as turning on the water faucet while the patient is trying to void, may also be used. Other examples of trigger techniques are stroking the abdomen or inner thighs, tapping above the pubic area, and dipping the patient's hands in warm water. After surgery or childbirth, prescribed analgesic agents should be given because pain in the perineal area can make voiding difficult. A combination of techniques may be necessary to initiate voiding.

When the patient cannot void, bladder scanning is used to assess for distension, then straight catheterization (as prescribed) is used to prevent overdistention of the bladder (see later discussion of neurogenic bladder and catheterization). In the case of prostatic obstruction, attempts at catheterization (by the urologist) may not be successful, requiring insertion of a suprapubic catheter (catheter inserted through a small abdominal incision into the bladder). After urinary drainage is restored, bladder retraining is initiated for the patient who cannot void spontaneously.

Promoting Home, Community-Based, and Transitional Care

In addition to the strategies listed for promoting urinary continence found in Chart 45-9, modifications to the home environment can provide simple and effective ways to assist in treating urinary incontinence and retention. For example, the patient may need to remove obstacles, such as throw rugs or other objects, to provide easy, safe access to the bathroom. Other modifications that the nurse may recommend include installing support bars in the bathroom; placing a bedside commode, bedpan, or urinal within easy reach; leaving lights on in the bedroom and bathroom; and wearing clothing that is easy to remove quickly.

Neurogenic Bladder

Neurogenic bladder is a dysfunction that results from a disorder or dysfunction of the nervous system and leads to urinary incontinence. It may be caused by spinal cord injury, spinal tumor, herniated vertebral disc, multiple sclerosis, congenital disorders (spina bifida or myelomeningocele), infection, or complications of diabetes (Bader, Littlejohns, & Olson, 2016) (see Chapter 51).

Pathophysiology

The two types of neurogenic bladder are spastic (or reflex) bladder and flaccid bladder. Spastic bladder is the more common type and is caused by any spinal cord lesion above the voiding reflex arc (upper motor neuron lesion) (Bader et al., 2016). The result is a loss of conscious sensation and cerebral motor control. A spastic bladder empties on reflex, with minimal or no controlling influence to regulate its activity.

Flaccid bladder is caused by a lower motor neuron lesion, commonly resulting from trauma. This form of neurogenic bladder is also increasingly being recognized in patients with diabetes. The bladder continues to fill and becomes greatly distended, and overflow incontinence occurs. The bladder muscle does not contract forcefully at any time. Because sensory loss may accompany a flaccid bladder, the patient feels no discomfort.

Assessment and Diagnostic Findings

Evaluation for neurogenic bladder involves measurement of fluid intake, urine output, and residual urine volume; urinalysis; and assessment of sensory awareness of bladder fullness and degree of motor control. Comprehensive urodynamic studies are also performed.

Complications

The most common complication of neurogenic bladder is infection resulting from urinary stasis and catheterization. Other complications include renal calculi, impaired skin integrity, and urinary incontinence or retention (Bader et al., 2016).

Medical Management

The problems resulting from neurogenic bladder disorders vary considerably from patient to patient and are a major challenge to the health care team. Several long-term objectives appropriate for all types of neurogenic bladders include preventing overdistention of the bladder, emptying the bladder regularly and completely, maintaining urine sterility with no stone formation, and maintaining adequate bladder capacity with no reflux.

Specific interventions include continuous, intermittent, or self-catheterization (discussed later in this chapter); the use of an external condom-type catheter; a diet low in calcium (to prevent calculi); and encouragement of mobility and ambulation. A liberal fluid intake is encouraged to reduce the urinary bacterial count, reduce stasis, decrease the concentration of calcium in the urine, and minimize the precipitation of urinary crystals and subsequent stone formation.

A bladder retraining program may be effective in treating a spastic bladder or urine retention. The use of a timed, or habit, voiding schedule may be established. To further enhance emptying of a flaccid bladder, the patient may be taught to "double void." After each voiding, the patient is instructed to remain on the toilet, relax for 1 to 2 minutes, and then attempt to void again in an effort to further empty the bladder.

Pharmacologic Therapy

Parasympathomimetic medications, such as bethanechol (Urecholine), may help to increase the contraction of the detrusor muscle.

Surgical Management

Surgery may be carried out to correct bladder neck contractures or vesicoureteral reflux, or to perform a urinary diversion procedure.

Catheterization

In patients with a urologic disorder or with marginal kidney function, care must be taken to ensure that urinary drainage

is adequate and that kidney function is preserved. When urine cannot be eliminated naturally and must be drained artificially, catheters may be inserted directly into the bladder, the ureter, or the renal pelvis. Catheters vary in size, shape, length, material, and configuration (Carter et al., 2014). The type of catheter used depends on its purpose.

Catheterization is performed to achieve the following:

- Relieve urinary tract obstruction
- Assist with postoperative drainage in urologic and other surgeries
- Provide a means to monitor accurate urine output in patients who are critically ill
- Promote urinary drainage in patients with neurogenic bladder dysfunction or urine retention
- Prevent urinary leakage in patients with stage III to IV pressure ulcers (see Chapter 51)

A patient should be catheterized only if necessary, because catheterization commonly leads to UTI. Catheters impede most of the natural defenses of the lower urinary tract by obstructing the periurethral ducts, irritating the bladder mucosa, and providing an artificial route for organisms to enter the bladder (Hagerty et al., 2015). Organisms may be introduced from the urethra into the bladder during catheterization, or they may migrate along the epithelial surface of the urethra or external surface of the catheter. In addition, urinary catheters have been associated with other complications, such as bladder spasms, urethral strictures, and pressure necrosis (Bader et al., 2016).

Indwelling Catheters

When an indwelling catheter cannot be avoided, a closed drainage system is essential. This drainage system is designed to prevent any disconnections, thereby reducing the risk of contamination. Triple-lumen catheters are commonly used after transurethral prostate surgery (see Chapter 46). This system has a triple-lumen indwelling urethral catheter attached to a closed sterile drainage system. With the triple-lumen catheter, urinary drainage occurs through one channel. The retention balloon of the catheter is inflated with water or air through the second channel, and the bladder is continuously irrigated with sterile irrigating solution through the third channel.

The spout (or drainage port) of any urinary drainage bag can become contaminated when opened to drain the bag. Bacteria enter the urinary drainage bag, multiply rapidly, and then migrate to the drainage tubing, catheter, and bladder. By keeping the drainage bag lower than the patient's bladder and not allowing urine to flow back into the bladder, this risk is reduced.

Suprapubic Catheters

Suprapubic catheterization allows bladder drainage by inserting a catheter or tube into the bladder through a suprapubic (above the pubis) incision or puncture (see Fig. 45-3). The catheter or suprapubic drainage tube is then threaded into the bladder and secured with sutures or tape, and the area around the catheter is covered with a sterile dressing. The catheter is connected to a sterile closed drainage system, and the tubing is secured to prevent tension on the catheter. This may be a temporary measure to divert the flow of urine from the urethra when the urethral route is impassable (because of injuries, strictures, prostatic obstruction), after gynecologic or other abdominal surgery when bladder dysfunction is likely to occur, and occasionally after pelvic fractures.

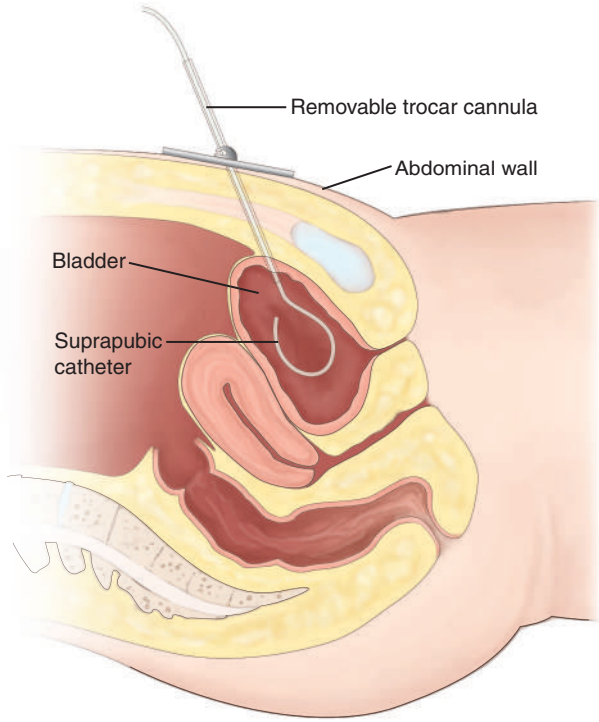


Figure 45-3 • Suprapubic bladder drainage. A trocar cannula is used to puncture the abdominal and bladder walls. The catheter is threaded through the trocar cannula, which is then removed, leaving the catheter in place. The catheter is secured by tape or sutures to prevent unintentional removal.

Suprapubic bladder drainage may be maintained continuously for several weeks. When the patient's ability to void is to be tested, the catheter is clamped for 4 hours, during which time the patient attempts to void. After the patient voids, the catheter is unclamped, and the residual urine is measured. If the amount of residual urine is less than 100 mL on two separate occasions (morning and evening), the catheter is usually removed. However, if the patient complains of pain or discomfort, the suprapubic catheter is usually left in place until the patient can void successfully.

Suprapubic drainage offers certain advantages. Patients can usually void sooner after surgery than those with urethral catheters, and they may be more comfortable. The catheter allows greater mobility, permits measurement of residual urine without urethral instrumentation, and presents less risk of bladder infection. The suprapubic catheter is removed when it is no longer required, and a sterile dressing is placed over the site.

The patient requires liberal amounts of fluid to prevent encrustation around the catheter. Other potential problems include the formation of bladder stones, acute and chronic infections, and problems collecting urine. A enterostomal therapy (ET) nurse may be consulted to assist the patient and family in selecting the most suitable urine collection system and to educate them about its use and care.

Nursing Management

Assessing the Patient and the System

For patients with indwelling catheters, the nurse assesses the drainage system to ensure that it provides adequate urinary drainage. The color, odor, and volume of urine are also monitored. An accurate record of fluid intake and urine output

provides essential information about the adequacy of kidney function and urinary drainage.

Patients at high risk for UTI from catheterization need to be identified and monitored carefully. These include women; older adults; and patients who are debilitated, malnourished, chronically ill, immunosuppressed, or have diabetes (Carter et al., 2014); (Hagerty et al., 2015). They are observed for signs and symptoms of UTI: cloudy malodorous urine, hematuria, fever, chills, anorexia, and malaise. Any drainage and excoriation in the area around the urethral orifice is noted. Urine cultures provide the most accurate means of assessing a patient for infection.

Gerontologic Considerations

The older patient with an indwelling catheter may not exhibit the typical signs and symptoms of infection (Eliopoulos, 2018). Therefore, any subtle change in physical condition or mental status must be considered a possible indication of infection and promptly investigated because sepsis may occur before the infection is diagnosed. Figure 45-4 summarizes the sequence of events leading to infection and leakage of urine that often follow long-term use of an indwelling catheter in an older patient (Miller, 2015).

Preventing Infection

Certain principles of care are essential to prevent infection in patients with a closed urinary drainage system (see Chart 45-10). The catheter is an object foreign to the body and produces a reaction in the urethral mucosa with some urethral discharge. Vigorous cleansing of the meatus while the catheter is in place is discouraged because the cleansing action can move the catheter back and forth, increasing the risk of infection. To clean the external catheter surface, gentle washing with soap and water or wipes during the daily bath is used by some (Strouse, 2015). Others report that using 2% chlorhexidine gluconate no-rinse wipes during the daily bath helps decrease CAUTI rates (Carter et al., 2014). The catheter is anchored as securely as possible to prevent it from moving in the urethra (Carter et al., 2014); (Mori, 2014).

A liberal fluid intake, within the limits of the patient's cardiac and renal reserve, and an increased urine output must be ensured to flush the catheter and to dilute urinary substances that might form encrustations (Carter et al., 2014); (Hagerty et al., 2015).

Urine cultures are obtained as prescribed or indicated when monitoring the patient for infection; many catheters have an aspiration (puncture) port from which a specimen can be obtained.

Bacteriuria is considered inevitable in patients with indwelling catheters; therefore, controversy remains about the usefulness of taking cultures and treating asymptomatic bacteriuria, because overtreatment may lead to resistant strains of bacteria. Continual observation for fever, chills, and other signs and symptoms of systemic infection is necessary. Infections are treated aggressively.

Minimizing Trauma

Trauma to the urethra can be minimized by:

- Using an appropriately sized catheter
- Lubricating the catheter adequately with a water-soluble lubricant during insertion
- Inserting the catheter far enough into the bladder to prevent trauma to the urethral tissues when the retention balloon of the catheter is inflated

Manipulation of the catheter is the most common cause of trauma to the bladder mucosa in the catheterized patient. Infection can occur when urine invades the damaged mucosa.

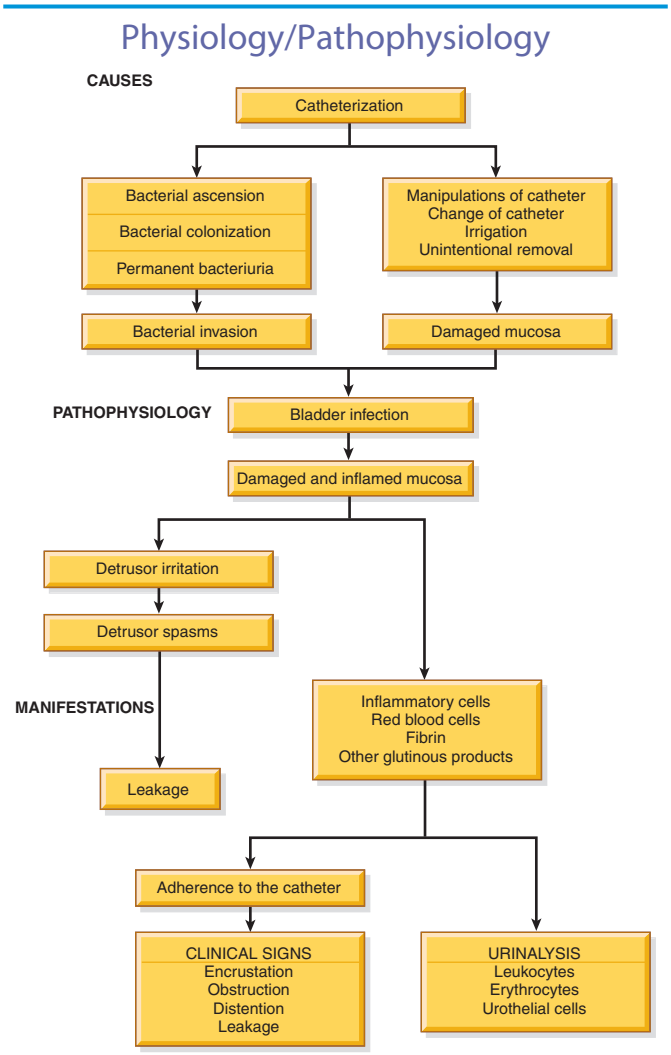


Figure 45-4 • Pathophysiology and manifestations of bladder infection with long-term catheterization in older patients.

The catheter is secured properly to prevent it from moving, causing traction on the urethra, or being unintentionally removed, and care is taken to ensure that the catheter position permits leg movement. In male patients, the drainage tube (not the catheter) is taped laterally to the thigh to prevent pressure on the urethra at the penoscrotal junction, which can eventually lead to formation of a urethrocutaneous fistula. In female patients, the drainage tubing attached to the catheter is taped to the thigh to prevent tension and traction on the bladder.

Special care should be taken to ensure that any patient who is confused does not remove the catheter with the retention balloon still inflated, because this could cause bleeding and considerable injury to the urethra.

Retraining the Bladder

When an indwelling urinary catheter is in place, the detrusor muscle does not actively contract the bladder wall to stimulate emptying because urine is continuously draining from the bladder. As a result, the detrusor may not immediately respond to bladder filling when the catheter is removed, resulting in either urine retention or urinary incontinence. This condition, known as postcatheterization detrusor instability, can be managed with bladder retraining (see Chart 45-11).

Chart 45-10

Preventing Infection in the Patient with an Indwelling Urinary Catheter

- Avoid contamination of the drainage spout. A receptacle in which to empty the bag is provided for each patient.
- Avoid routine catheter changes. The catheter is changed only to correct problems such as leakage, blockage, or encrustations.
- Avoid unnecessary handling or manipulation of the catheter by the patient or staff.
- Carry out hand hygiene before and after handling the catheter, tubing, or drainage bag.
- Ensure a free flow of urine to prevent infection. Improper drainage occurs when the tubing is kinked or twisted, allowing pools of urine to collect in the tubing loops.
- Evaluate the benefit of placing an indwelling urinary catheter versus the risk the patient developing a catheter-associated urinary tract infection.
- If the collection bag *must* be raised above the level of the patient's bladder, clamp the drainage tube. This prevents backflow of contaminated urine into the patient's bladder from the bag.
- Monitor the patient's voiding when the catheter is removed. The patient must void within 8 hours; if unable to void, the patient may require catheterization with a straight catheter.
- Never disconnect the tubing to obtain urine samples, to irrigate the catheter, or to ambulate or transport the patient.
- Never irrigate the catheter routinely. If the patient is prone to obstruction from clots or large amounts of sediment, use a three-way system with continuous irrigation.
- Never leave the catheter in place longer than is necessary to decrease the risk of CAUTI.
- Obtain a urine specimen for culture at the first sign of infection.
- To prevent contamination of the closed system, *never* disconnect the tubing. The drainage bag must *never* touch the floor. The bag and collecting tubing are changed if contamination occurs, if urine flow becomes obstructed, or if tubing junctions start to leak at the connections.
- To reduce the risk of bacterial proliferation, empty the collection bag at least every 8 hours through the drainage spout—more frequently if there is a large volume of urine.
- Use scrupulous aseptic technique during insertion of the catheter. Use a preassembled, sterile, closed urinary drainage system of the smallest catheter size possible to minimize trauma.
- Wash the perineal area with soap and water at least twice a day; avoid a to-and-fro motion of the catheter. Dry the area well, but avoid applying powder because it may irritate the perineum.

Adapted from Carter, N. M., Reitmeier, L., & Goodloe, L. R. (2014). An evidence-based approach to the prevention of catheter-associated urinary tract infections. Urologic Nursing, 34(5), 238–245.

Chart 45-11

Bladder Retraining After Indwelling Catheterization

- Instruct the patient to drink a measured amount of fluid from 8 AM to 10 PM to avoid bladder overdistention. Offer no fluids (except sips) after 10 PM.
- At specific times, ask the patient to void by applying pressure over the bladder, tapping the abdomen, or running water to trigger the bladder.
- Immediately after the voiding attempt, perform a bladder scan to determine the amount of residual urine.
- Measure the volumes of urine voided.
- Palpate the bladder at repeated intervals to assess for distention.
- Instruct the patient who has no voiding sensation to be alert to any signs that indicate a full bladder, such as perspiration, cold hands or feet, or feelings of anxiety.
- Perform straight catheterization, as prescribed, usually for residual urine of >300 mL.
- Lengthen the intervals between catheterizations as the volume of residual urine decreases. Catheterization is usually discontinued when the volume of residual urine is <100 mL.

Adapted from Carter, N. M., Reitmeier, L., & Goodloe, L. R. (2014). An evidence-based approach to the prevention of catheter-associated urinary tract infections. Urologic Nursing, 34(5), 238–245.

Immediately after the indwelling catheter is removed, the patient is placed on a timed voiding schedule, usually every 2 to 3 hours. At the given time interval, the patient is instructed to void. The bladder is then scanned using a portable ultrasonic bladder scanner, and if the bladder has not emptied completely, straight catheterization may be performed (Carter et al., 2014); (Mori, 2014). After a few days, as the nerve endings in the bladder wall become resensitized to the bladder filling and emptying, bladder function usually returns to normal. If the patient has had an indwelling catheter in place for an extended period (e.g., greater than 1 month), bladder retraining will take longer; in some cases, function may never return to normal, and long-term intermittent catheterization may become necessary.

Assisting With Intermittent Self-Catheterization

Intermittent self-catheterization provides periodic drainage of urine from the bladder. By promoting drainage and eliminating excessive residual urine, intermittent catheterization protects the kidneys, reduces the incidence of UTIs, and improves continence. It is the treatment of choice in some patients with spinal cord injury and other neurologic disorders, such as multiple sclerosis, when the ability to empty the bladder is impaired. Self-catheterization promotes independence, results in few complications, and enhances self-esteem and quality of life.

When educating the patient about how to perform self-catheterization, the nurse must use aseptic technique to minimize the risk of cross-contamination. However, the patient may use a "clean" (nonsterile) technique at home, where the risk of cross-contamination is reduced. Either antibacterial liquid soap or povidone-iodine (Betadine) solution is recommended for cleaning urinary catheters at home. The catheter is thoroughly rinsed with warm tap water after soaking in the cleaning solution. It must dry before reuse. It should be kept in its own container, such as a plastic food storage bag.

In educating the patient, the nurse emphasizes the importance of frequent catheterization and emptying the bladder at the prescribed time. The average daytime clean intermittent catheterization schedule is every 4 to 6 hours and just before bedtime. If the patient is awakened at night with an urge to void, catheterization may be performed after an attempt is made to void normally.

The female patient assumes a Fowler position and uses a mirror to help locate the urinary meatus. She lubricates the catheter and inserts it 7.5 cm (3 inches) into the urethra, in a downward and backward direction. The male patient assumes a

Fowler or sitting position, lubricates the catheter, and retracts the foreskin of the penis with one hand while grasping the penis and holding it at a right angle to the body. (This maneuver straightens the urethra and makes it easier to insert the catheter.) He inserts the catheter 15 to 25 cm (6 to 10 inches) until urine begins to flow. After removal, the catheter is cleaned, rinsed, dried, and placed in a plastic bag or case. Patients who follow an intermittent catheterization routine should consult a primary provider at regular intervals to assess urinary function and to detect complications. If the patient cannot perform intermittent self-catheterization, a family member or caregiver may be taught to carry out the procedure at regular intervals during the day.

An alternative to self-catheterization is creation of the Mitrofanoff umbilical appendicovesicostomy, which provides easy access to the bladder but requires an extensive surgical procedure (Wille, Zagaja, Shalhav, et al., 2011). In this procedure, the bladder neck is closed and the appendix is used to create access to the bladder from the skin surface through a submucosal tunnel created with the appendix. One end of the appendix is brought to the skin surface and used as a stoma, and the other end is tunneled into the bladder. The appendix serves as an artificial urinary sphincter when an alternative is necessary to empty the bladder. A surgically prepared continent urine reservoir with a sphincter mechanism is required in cases of bladder cancer and severe interstitial cystitis. Various types of urinary diversions may be used when a radical cystectomy (surgical removal of the bladder) is necessary (see discussion later in chapter).

UROLITHIASIS AND NEPHROLITHIASIS

Urolithiasis and nephrolithiasis refer to stones (calculi) in the urinary tract and kidney, respectively. Urinary stones predominantly occur in the third to fifth decades of life and affect men twice as often as women (Cunningham, Noble, Al-Modhefer, et al., 2016). Stones may develop in one or both kidneys and yearly episodes are increasing (Cunningham et al., 2016). Incidence of renal stones is more in countries that fall in tropical region. These countries are called *stone belt*. Saudi Arabia, Sudan, Egypt, UAE, Iran, Pakistan, India, Myanmar, Thailand, Indonesia, and Philippines are part of the stone belt. The prevalence of renal calculi is high in North India compared to South India. Maharashtra has the highest prevalence of renal calculi (7.6%) and Rajasthan has prevalence rate of 3–5% (Kumari, Dokwal, Mittal, et al., 2016).

Pathophysiology

When total urine volume decreases (<2 L/day), the concentration of urinary calcium oxalates, calcium phosphates, and uric acid increases. With increased urinary concentrations of these substances, stones are formed in the urinary tract. Referred to as supersaturation, this depends on the amount of the substance, ionic strength, and pH of the urine. Stones may be found anywhere from the kidney to the bladder and may vary in size from minute granular deposits, called *sand* or *gravel,* to bladder stones as large as an orange. The different sites of calculi formation in the urinary tract are shown in Figure 45-5.

Certain factors favor the formation of stones, including infection, urinary stasis, and periods of immobility, all of which slow kidney drainage and alter calcium metabolism (Grossman & Porth, 2014). In addition, increased calcium concentrations in the blood and urine promote precipitation of calcium and formation of stones (about 80% of all kidney stones are calcium

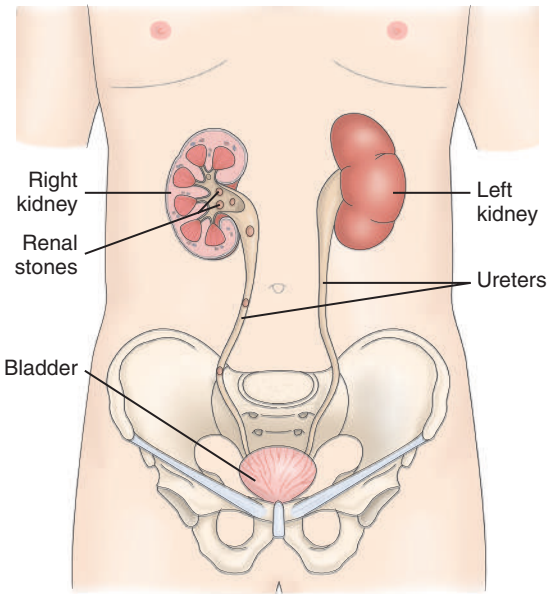


Figure 45-5 • Examples of potential sites of calculi formation (urolithiasis) in the urinary tract.

based) (Cunningham et al., 2016). Causes of hypercalcemia (high serum calcium) and hypercalciuria (high urine calcium) may include the following:

- Hyperparathyroidism
- Renal tubular acidosis
- Cancers (e.g., leukemia, multiple myeloma)
- Dehydration
- Granulomatous diseases (e.g., sarcoidosis, tuberculosis), which may cause increased vitamin D production by the granulomatous tissue
- Excessive intake of vitamin D
- Excessive intake of milk and alkali
- Myeloproliferative diseases such as polycythemia vera, which produce an unusual proliferation of blood cells from the bone marrow

For patients with stones containing uric acid, struvite, or cystine, a thorough physical examination and metabolic workup are indicated because of associated disturbances contributing to the stone formation. Uric acid stones (5% to 10% of all stones) may be seen in patients with gout or myeloproliferative disorders. Struvite stones account for 15% of urinary calculi and form in persistently alkaline, ammonia-rich urine caused by the presence of urease-splitting bacteria such as *Proteus, Pseudomonas, Klebsiella, Staphylococcus,* or *Mycoplasma* species. Predisposing factors for struvite stones include neurogenic bladder, foreign bodies, and recurrent UTIs.

Several conditions, as well as certain metabolic risk factors, predispose patients to stone formation. These include anatomic derangements such as polycystic kidney disease, horseshoe kidneys, chronic strictures, and medullary sponge disease. Urinary stone formation can occur in patients with inflammatory bowel disease and in those with an ileostomy or bowel resection because these patients absorb more oxalate. Medications known to cause stones in some patients include antacids, acetazolamide (Diamox), vitamin D, laxatives, and high doses of aspirin (Comerford, 2015). However, in many patients, no cause may be found.

Pathophysiology of urolithiasis/nephrolithiasis is presented in Figure 45-6.

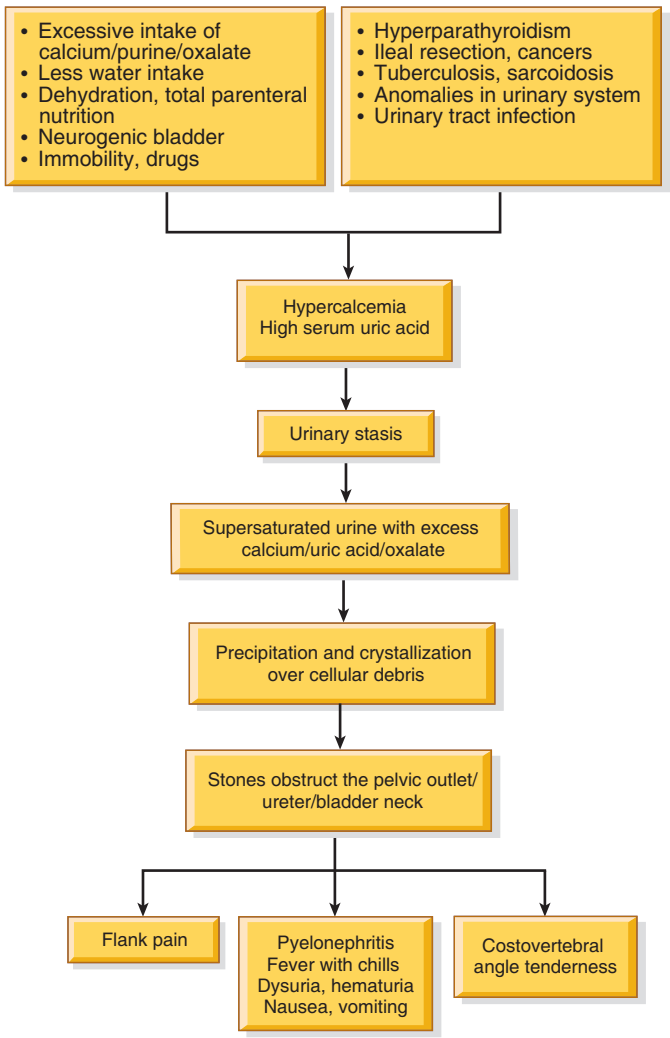


Figure 45-6 • Pathophysiology of urolithiasis/nephrolithiasis.

Clinical Manifestations

Signs and symptoms of stones in the urinary system depend on the presence of obstruction, infection, and edema. When stones block the flow of urine, obstruction develops, producing an increase in hydrostatic pressure and distending the renal pelvis and proximal ureter (Cunningham et al., 2016). Infection (pyelonephritis and UTI with chills, fever, and frequency) can be a contributing factor with struvite stones. Some stones cause few, if any, symptoms while slowly destroying the functional units (nephrons) of the kidney; others cause excruciating pain and discomfort.

Stones in the renal pelvis may be associated with an intense, deep ache in the costovertebral region. Hematuria is often present. On the contrary, an Indian study conducted in Imphal, Manipur, reported that majority of the patients (57.8%) diagnosed with urolithiasis were asymptomatic at the time of presentation (Faridi & Singh, 2020).

Pyuria may also be noted. Pain originating in the renal area radiates anteriorly and downward toward the bladder in the female and toward the testes in the male. If the pain suddenly becomes acute, with tenderness over the costovertebral area, and nausea and vomiting occur, the patient is having an episode of renal colic. Diarrhea and abdominal discomfort are due to renointestinal reflexes and the anatomic proximity of the kidneys to the stomach, pancreas, and large intestine.

Stones lodged in the ureter (ureteral obstruction) cause acute, excruciating, colicky, wavelike pain that radiates down the thigh and to the genitalia. Often, the patient has a desire to void, but little urine is passed, and it usually contains blood because of the abrasive action of the stone. This group of symptoms is called *ureteral colic*. Colic is mediated by prostaglandin E, a substance that increases ureteral contractility and renal blood flow and that leads to increased intraureteral pressure and pain. In general, the patient is able to pass stones 0.5 to 1 cm in diameter. Stones larger than 1 cm in diameter usually must be removed or fragmented (broken up by lithotripsy) so that they can be removed or passed spontaneously.

Stones lodged in the bladder usually produce symptoms of irritation and may be associated with UTI and hematuria. If the stone obstructs the bladder neck, urinary retention occurs. If infection is associated with a stone, the condition is far more serious, with the potential for developing urosepsis.

Assessment and Diagnostic Findings

The diagnosis is confirmed by a noncontrast CT scan (Cunningham et al., 2016). Blood chemistries and a 24-hour urine test for measurement of calcium, uric acid, creatinine, sodium, pH, and total volume may be part of the diagnostic workup. Dietary and medication histories and family history of kidney stones are obtained to identify factors predisposing the patient to the formation of stones.

When stones are recovered (whether freely passed by the patient or removed through special procedures), chemical analysis is carried out to determine their composition. Stone analysis can provide a clear indication of the underlying disorder. For example, calcium oxalate or calcium phosphate stones usually indicate disorders of oxalate or calcium metabolism, whereas urate stones suggest a disturbance in uric acid metabolism (Cunningham et al., 2016).

Medical Management

The goals of management are to eradicate the stone, determine the stone type, prevent nephron destruction, control infection, and relieve any obstruction that may be present. The immediate objective of treatment of renal or ureteral colic is to relieve the pain until its cause can be eliminated. Opioid analgesic agents are given to prevent shock and syncope that may result from the excruciating pain. Nonsteroidal anti-inflammatory drugs (NSAIDs) are effective in treating kidney stone pain because they provide specific pain relief (Cunningham et al., 2016). They also inhibit the synthesis of prostaglandin E, reducing swelling and facilitating passage of the stone. Generally, once the stone has passed, the pain is relieved. Hot baths or moist heat to the flank area may also be helpful. Unless the patient is vomiting or has heart failure or any other condition requiring fluid restriction, fluids are encouraged. This increases the hydrostatic pressure behind the stone, assisting it in its downward passage. A high, around-the-clock fluid intake reduces the concentration of urinary crystalloids, dilutes the urine, and ensures a high urine output.

Nutritional Therapy

Nutritional therapy plays an important role in preventing kidney stones (Cunningham et al., 2016) (see Chart 45-12). Fluid intake is the mainstay of most medical therapy for kidney stones. Unless fluids are contraindicated, patients with kidney stones should

Chart 45-12 PATIENT EDUCATION

Preventing Kidney Stones

The nurse instructs the patient to:

- Avoid protein intake to decrease urinary excretion of calcium and uric acid. Nonvegetarian food items such as chicken, mutton, beef, pork, milk, and egg to be reduced.
- Limit sodium intake to 3–4 g/day. Table salt and high-sodium foods should be reduced, because sodium competes with calcium for reabsorption in the kidneys.
- Be aware that low-calcium diets are not generally recommended, except for true absorptive hypercalciuria. Evidence shows that limiting calcium, especially in women, can lead to osteoporosis and does not prevent stones.
- Avoid intake of oxalate-containing foods (e.g., spinach, strawberries, tomato, rhubarb, tea, peanuts, wheat bran).
- Drink fluids to a minimum of 3 to 4 liters per day (ideally water and one glass of cranberry juice per day) every 1–2 hours during the day. In Indian setting Tender coconut water will be helpful.
- Drink two glasses of water at bedtime and an additional glass at each nighttime awakening to prevent urine from becoming too concentrated during the night.
- Avoid activities leading to sudden increases in environmental temperatures that may cause excessive sweating and dehydration.
- Contact the primary provider at the first sign of a urinary tract infection.

drink at least 3 L of water daily or have IV fluids prescribed to keep the urine dilute. A urine output exceeding 2 L/day is advisable.

Calcium Stones

Historically, patients with calcium-based kidney stones were recommended to restrict calcium in their diet. However, evidence has questioned this practice, except for patients with type II absorptive hypercalciuria (half of all patients with calcium stones), in whom stones are clearly the result of excess dietary calcium. Liberal fluid intake is encouraged. Medications such as ammonium chloride may be used, and if increased parathormone production (resulting in increased serum calcium levels in blood and urine) is a factor in the formation of stones, therapy with thiazide diuretics may be beneficial in reducing the calcium loss in the urine and lowering the elevated parathormone levels (Cunningham et al., 2016).

Uric Acid Stones

For uric acid stones, the patient is placed on a low-purine diet to reduce the excretion of uric acid in the urine. Foods high in purine (shellfish, anchovies, asparagus, mushrooms, and organ meats) are avoided, and other proteins may be limited. Allopurinol (Zyloprim) may be prescribed to reduce serum uric acid levels and urinary uric acid excretion (Comerford, 2015).

Cystine Stones

A low-protein diet is prescribed, the urine is alkalinized, and fluid intake is increased.

Oxalate Stones

A dilute urine is maintained, and the intake of oxalate is limited. Many foods contain oxalate; however, only certain foods increase the urinary excretion of oxalate. These include spinach, strawberries, rhubarb, chocolate, tea, peanuts, and wheat bran.

Interventional Procedures

If the stone does not pass spontaneously or if complications occur, common interventions include endoscopic or other procedures. For example, ureteroscopy, extracorporeal shock wave lithotripsy (ESWL), or endourologic (percutaneous) stone removal may be necessary.

Ureteroscopy (see Fig. 45-7A) involves first visualizing the stone and then destroying it. Access to the stone is accomplished by inserting a ureteroscope into the ureter and then inserting a laser, electrohydraulic lithotriptor, or ultrasound device through the ureteroscope to fragment and remove the stones. A stent may be inserted and left in place for 48 hours or more after the procedure to keep the ureter patent. Length of hospital stay is generally brief, and some patients can be treated as outpatients.

ESWL is a noninvasive procedure used to break up stones in the calyx of the kidney (see Fig. 45-7B). After the stones are fragmented to the size of grains of sand, the remnants of the stones are spontaneously voided. In ESWL, a high-energy amplitude of pressure, or shock wave, is generated by the abrupt release of energy and transmitted through water and soft tissues. When the shock wave encounters a substance of different intensity (a kidney stone), a compression wave causes the surface of the stone to fragment. Repeated shock waves focused on the stone eventually reduce it to many small pieces that are excreted in the urine.

Discomfort from the multiple shocks may occur, although the shock waves usually do not cause damage to other tissue. The patient is observed for obstruction and infection resulting from blockage of the urinary tract by stone fragments. All urine is strained after the procedure; voided gravel or sand is sent to the laboratory for chemical analysis. Several treatments may be necessary to ensure disintegration of stones (Cunningham et al., 2016).

Endourologic methods of stone removal (see Fig. 45-7C) may be used to extract kidney calculi that cannot be removed by other procedures. A percutaneous nephrostomy or a percutaneous nephrolithotomy (which are similar procedures) may be performed. A nephroscope is introduced through a percutaneous route into the renal parenchyma. Depending on its size, the stone may be extracted with forceps or by a stone retrieval basket. If the stone is too large to initially be removed, an ultrasound probe inserted through a nephrostomy tube is used to pulverize the stone. Small stone fragments and stone dust are then removed.

Electrohydraulic lithotripsy is a similar method in which an electrical discharge is used to create a hydraulic shock wave to break up the stone. A probe is passed through the cystoscope, and the tip of the lithotriptor is placed near the stone. The strength of the discharge and pulse frequency can be varied. This procedure is performed under topical anesthesia. After the stone is extracted, the percutaneous nephrostomy tube is left in place for a time to ensure that the ureter is not obstructed by edema or blood clots. The most common complications are hemorrhage, infection, and urinary extravasation. After the tube is removed, the nephrostomy tract usually closes spontaneously.

Chemolysis, stone dissolution using infusions of chemical solutions (e.g., alkylating agents, acidifying agents) for the purpose of dissolving the stone, is an alternative treatment sometimes used in patients who are at risk for complications with other types of therapy, who refuse to undergo other methods, or who have stones (struvite) that dissolve easily. A percutaneous nephrostomy is performed, and the warm chemical solution is allowed to flow continuously onto the stone. The solution exits the renal collecting system by means of the ureter or the nephrostomy tube. The pressure inside the renal pelvis is monitored during the procedure.

Several of these treatment modalities may be used in combination to ensure removal of the stones.

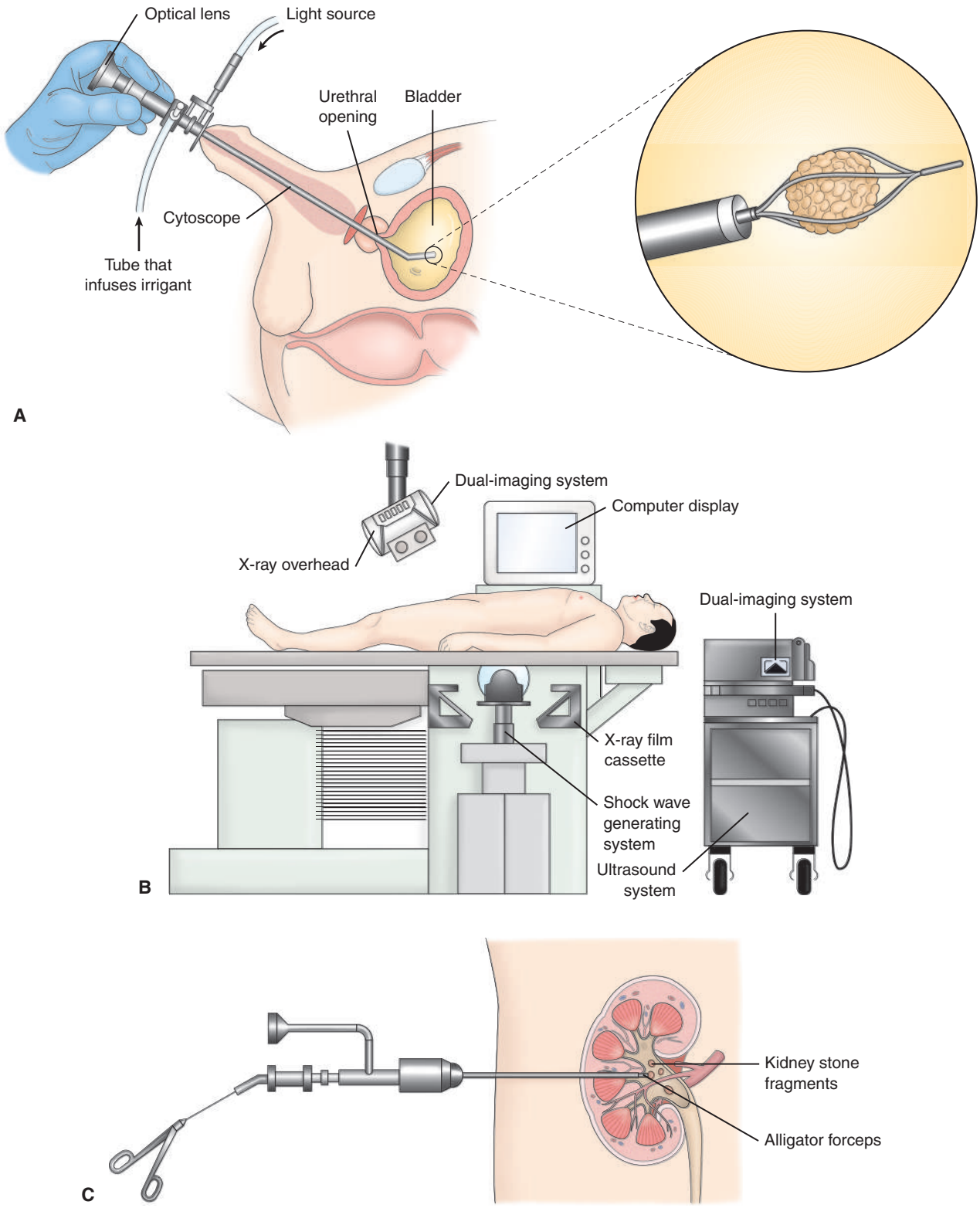


Figure 45-7 • Methods of treating kidney stones. **A**. During ureteroscopy, which is used for removing small stones located in the ureter close to the bladder, a ureteroscope is inserted into the ureter to visualize the stone. The stone is then fragmented or captured and removed. **B**. Extracorporeal shock water lithotripsy is used for most symptomatic, nonpassable upper urinary stones. Electromagnetically generated shock waves are focused over the area of the kidney stone. The high-energy dry shock waves pass through the skin and fragment the stone. **C**. Percutaneous nephrolithotomy is used to treat larger stones. A percutaneous tract is formed, and a nephroscope is inserted through it. Then, the stone is extracted or pulverized.

Surgical Management

Surgical removal was the major mode of therapy before the advent of lithotripsy. However, today, surgery is performed in only 1% to 2% of patients (Cunningham et al., 2016). Surgical intervention is indicated if the stone does not respond to other forms of treatment. It may also be performed to correct anatomic abnormalities within the kidney to improve urinary drainage. If the stone is in the kidney, the surgery performed may be a nephrolithotomy (incision into the kidney with removal of the stone) or a nephrectomy, if the kidney is nonfunctional secondary to infection or hydronephrosis. Stones in the kidney pelvis are removed by a pyelolithotomy, those in the ureter by ureterolithotomy, and those in the bladder by cystotomy. If the stone is in the bladder, an instrument may be inserted through the urethra into the bladder, and the stone crushed. Such a procedure is called a *cystolitholapaxy.* Nursing management following kidney surgery is discussed in Chapter 44.

NURSING PROCESS

The Patient With Kidney Stones

Assessment

The patient with suspected kidney stones is assessed for pain and discomfort as well as associated symptoms, such as nausea, vomiting, diarrhea, and abdominal distention. The severity and location of pain are determined, along with any radiation of the pain. Nursing assessment also includes observing for signs and symptoms of UTI (chills, fever, frequency, and hesitancy) and obstruction (frequent urination of small amounts, oliguria, or anuria). The urine is inspected for blood and is strained for stones or gravel.

The history focuses on factors that predispose the patient to urinary tract stones or that may have precipitated the current episode of renal or ureteral colic. The patient's knowledge about kidney stones and measures to prevent their occurrence or recurrence is also assessed.

Diagnosis

Nursing Diagnoses

Based on the assessment data, nursing diagnoses may include the following:

- Acute pain related to inflammation, obstruction, and abrasion of the urinary tract
- Deficient knowledge regarding prevention of recurrence of kidney stones

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Infection and urosepsis (from UTI and pyelonephritis)
- Obstruction of the urinary tract by a stone or edema with subsequent acute kidney injury

Planning and Goals

The major goals for the patient may include relief of pain and discomfort, prevention of recurrence of kidney stones, and absence of complications.

Nursing Interventions

Relieving Pain

Severe acute pain is often the presenting symptom of a patient with kidney and urinary calculi and requires immediate attention. Opioid analgesic agents (IV or intramuscular) may be prescribed and given to provide rapid relief along with an IV NSAID. The patient is encouraged and assisted to assume a position of comfort. If activity brings pain relief, the patient is assisted to ambulate. The pain level is monitored closely, and an increase in severity is reported promptly to the primary provider so that relief can be provided and additional treatment initiated.

Monitoring and Managing Potential Complications

Increased fluid intake is encouraged to prevent dehydration and increase hydrostatic pressure within the urinary tract to promote passage of the stone. If the patient cannot take adequate fluids orally, IV fluids are prescribed. The total urine output and patterns of voiding are monitored. Ambulation is encouraged as a means of moving the stone through the urinary tract.

All urine is strained because uric acid stones may crumble. Any blood clots passed in the urine should be crushed and the sides of the urinal and bedpan inspected for clinging stones. Because kidney stones increase the risk of infection, sepsis, and obstruction of the urinary tract, the patient is instructed to report decreased urine volume, bloody or cloudy urine, fever, and pain.

Patients with calculi require frequent nursing observation to detect the spontaneous passage of a stone. The patient is instructed to immediately report any sudden increases in pain intensity because of the possibility of a stone fragment obstructing a ureter. Vital signs, including temperature, are monitored closely to detect early signs of infection. UTIs may be associated with kidney stones due to an obstruction from the stone or from the stone itself. All infections should be treated with the appropriate antibiotic agent before efforts are made to dissolve the stone.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care. Because the risk of recurring kidney stones is high, the nurse provides education about the causes of kidney stones and recommendations to prevent their recurrence (see Chart 45-12). The patient is encouraged to follow a regimen to avoid further stone formation, including maintaining a high fluid intake because stones form more readily in concentrated urine. A patient who has shown a tendency to form stones should drink enough fluid to excrete greater than 2000 mL (preferably 3000 to 4000 mL) of urine every 24 hours (Cunningham et al., 2016).

Urine cultures may be performed every 1 to 2 months in the first year and periodically thereafter. Recurrent UTI is treated vigorously. Because prolonged immobilization slows renal drainage and alters calcium metabolism, increased mobility is encouraged whenever possible. In addition, excessive ingestion of vitamins (especially vitamin D) and minerals is discouraged.

If lithotripsy, percutaneous stone removal, ureteroscopy, or other surgical procedures for stone removal have been performed, the nurse instructs the patient about the signs and symptoms of complications (e.g., urinary retention, infection) that need to be reported to the primary provider. The importance of follow-up to assess kidney function and to ensure the eradication or removal of all kidney stones is emphasized to the patient and family.

If ESWL has been performed, the nurse must provide instructions for home care and necessary follow-up. The patient is encouraged to increase fluid intake to assist in the passage of stone fragments, which may occur for 6 weeks to several months after the procedure. The patient and family are instructed about signs and symptoms of complications. It is also important to inform the patient to expect hematuria (it is anticipated in all patients), but it should disappear within 4 to 5 days. If the patient

has a stent in the ureter, hematuria may be expected until the stent is removed. The patient is instructed to check their temperature daily and notify the primary provider if the temperature is greater than 38°C (about 101°F) or the pain is unrelieved by the prescribed medication. The patient is also informed that a bruise may be observed on the treated side of the back.

Continuing and Transitional Care. Close monitoring of the patient in follow-up care is essential to ensure that treatment has been effective and that no complications develop. The nurse has the opportunity to assess the patient's understanding of ESWL and possible complications. In addition, the nurse has the opportunity to assess the patient's understanding of factors that increase the risk of recurrence of renal calculi and strategies to reduce those risks.

The nurse must assess the patient's ability to monitor urinary pH and interpret the results during follow-up visits. Because of the high risk of recurrence, the patient with kidney stones needs to understand the signs and symptoms of stone formation, obstruction, and infection and the importance of reporting these signs promptly. If medications are prescribed for the prevention of stone formation, the nurse explains their actions, importance, and side effects to the patient.

Evaluation

Expected patient outcomes may include:

1. Reports relief of pain
2. States increased knowledge of health-seeking behaviors to prevent recurrence
   a. Consumes increased fluid intake (at least 3L of water per day)
   b. Participates in appropriate activity
   c. Consumes diet prescribed to reduce dietary factors predisposing to stone formation
   d. Recognizes symptoms (fever, chills, flank pain, hematuria) to be reported to primary provider
   e. Monitors urinary pH as directed
   f. Takes prescribed medication as directed to reduce stone formation
3. Experiences no complications
   a. Reports no signs or symptoms of infection or urosepsis
   b. Voids 200 to 400 mL per voiding of clear urine without evidence of bleeding
   c. Experiences absence of urgency, frequency, and hesitancy
   d. Maintains normal body temperature

GENITOURINARY TRAUMA

Various types of injuries to the flank, back, or upper abdomen may result in trauma to the ureters, bladder, or urethra. Abdominal trauma is responsible for approximately 90% of all genitourinary trauma (Hallis, Amasyali, Yucak, et al., 2015). Kidney trauma is discussed in Chapter 44.

Specific Injuries

Ureteral Trauma

The main causes are motor vehicle crashes, sports injuries, falls, and assaults (Hallis et al., 2015). Injuries range from contusions to complete transection. Unintentional injury to the ureter may occur during gynecologic or urologic surgery. There are no specific signs or symptoms of ureteral injury; many traumatic injuries are discovered during exploratory surgery. Surgical repair with placement of stents (to divert urine away from an anastomosis) is usually necessary. If the ureteral trauma is not detected and urine leakage continues, fistulas can develop.

Bladder Trauma

Injury to the bladder may occur with pelvic fractures, multiple trauma, or from a blow to the lower abdomen when the bladder is full. Blunt trauma may result in contusion evident as an ecchymosis—a large bruise resulting from escape of blood into the tissues and involving a segment of the bladder wall—or in rupture of the bladder extraperitoneally, intraperitoneally, or both. Complications from these injuries include hemorrhage, shock, sepsis, and extravasation of blood into the tissues, which must be treated promptly.

Urethral Trauma

Urethral injuries usually occur with blunt trauma to the lower abdomen or pelvic region. Many patients also have associated pelvic fractures. The classic triad of symptoms comprises blood at the urinary meatus, inability to void, and a distended bladder.

Medical Management

The goals of management in patients with genitourinary trauma are to control hemorrhage, pain, and infection and to maintain urinary drainage. Genitourinary trauma is frequently associated with kidney trauma (see Chapter 44). Hematocrit and hemoglobin levels are monitored closely; decreasing values can indicate hemorrhage within the genitourinary system. The patient is also monitored for oliguria, signs of hemorrhagic shock, and signs and symptoms of acute peritonitis.

Surgical Management

In urethral trauma, a patient whose condition is unstable and who needs monitoring of urine output may need a suprapubic catheter inserted. The patient is catheterized after urethrography has been performed to minimize the risk of urethral disruption and extensive, long-term complications, such as stricture, incontinence, and impotence. Surgical repair may be performed using either open or laparoscopic approaches (Hallis et al., 2015). After surgery, an indwelling urinary catheter may remain in place for up to 1 month.

Nursing Management

The patient with genitourinary trauma should be assessed frequently during the first few days after injury to detect flank and abdominal pain, muscle spasm, and swelling over the flank.

During this time, patients are instructed about care of the incision and the importance of an adequate fluid intake. In addition, instructions about changes that should be reported to the primary provider, such as fever, hematuria, flank pain, or any signs and symptoms of decreasing kidney function, are provided (Hallis et al., 2015). The patient with a ruptured bladder may have gross bleeding for several days after repair. Guidelines for increasing activity gradually, lifting, and driving are also provided.

Follow-up nursing care includes monitoring the blood pressure to detect hypertension and advising the patient to restrict activities for about 1 month after trauma to minimize the incidence of delayed or secondary bleeding.

URINARY TRACT CANCERS

Urinary tract cancers include those of the urinary bladder; kidney and renal pelvis; ureters; and other urinary structures, such as the prostate. Kidney cancer is discussed in Chapter 44, and prostate cancer is discussed in Chapter 46.

Cancer of the Bladder

Cancer of the urinary bladder is more common in people older than 55years. As per the ICMR data, the incidence of bladder cancer among Indians was 26,886 in 2015 and it is predicted that by the year 2020 it may go up to 33,608 (ICMR, 2016). Cancers arising from the prostate, colon, and rectum in males and from the lower gynecologic tract in females may metastasize to the bladder.

Tobacco use continues to be a leading risk factor for all urinary tract cancers. People who smoke develop bladder cancer twice as often as those who do not smoke (NCI, 2016) (see Chart 45-13).

Clinical Manifestations

Bladder tumors usually arise at the base of the bladder and involve the ureteral orifices and bladder neck. Visible, painless hematuria is the most common symptom of bladder cancer. Infection of the urinary tract is a common complication, producing frequency and urgency. However, any alteration in voiding or change in the urine may indicate cancer of the bladder. Pelvic or back pain may occur with metastasis.

Assessment and Diagnostic Findings

The diagnostic evaluation includes ureteroscopy (the mainstay of diagnosis), excretory urography, CT and MRI scans, ultrasonography, and bimanual examination with the patient anesthetized. Biopsies of the tumor and adjacent mucosa are the definitive diagnostic procedures (NCI, 2016). Transitional cell carcinomas and carcinomas in situ shed recognizable cancer cells. Cytologic examination of fresh urine and saline bladder washings provide information about the prognosis and staging, especially for patients at high risk for recurrence of primary bladder tumors. See Chapter 58 for more information on cancer grading and staging.

Chart 45-13 SELECTED RISK FACTORS

Bladder Cancer

- Certain genetic mutations including:
  - *HRAS* mutation (Costello syndrome, Facio-cutaneous-skeletal syndrome).
  - *Rb1* mutation.
  - *PTEN/MMAC1* mutation (Cowden syndrome).
  - *NAT2* slow acetylator phenotype.
  - *GSTM1* null phenotype.
- Exposure to arsenic
- Occupational exposure to chemicals in processed paint, dye, metal, and petroleum products
- Positive family history of bladder cancer
- Pelvic radiation therapy or treatment for other cancers
- Tobacco use, cigarette smoking in particular

Adapted from National Cancer Institute (NCI). (2016). Bladder cancer treatment (PDQ®)–Health professional version. Retrieved 12/13/2016 at: www.cancer.gov/types/bladder/hp/bladder-treatment-pdq#section/all

Medical Management

Treatment of bladder cancer depends on the grade of the tumor (the degree of cellular differentiation), the stage of tumor growth (the degree of local invasion and the presence or absence of metastasis) (NCI, 2016). The patient's age and physical, mental, and emotional status are considered when determining treatment modalities.

Surgical Management

Transurethral resection or fulguration (cauterization) may be performed for simple papillomas (benign epithelial tumors). These procedures (described in more detail in Chapter 46) eradicate the tumors through surgical incision or electrical current with the use of instruments inserted through the urethra. After this bladder-sparing surgery, intravesical administration of bacille Calmette–Guérin (BCG) is the treatment of choice. BCG Live (TheraCys) is an attenuated live strain of *Mycobacterium bovis,* the causative agent in tuberculosis; treatment is recommended for a minimum of 1 year (NCI, 2016). The exact action of BCG is unknown, but it is thought to produce a local inflammatory and a systemic immunologic response.

Management of superficial bladder cancers presents a challenge because there are usually widespread abnormalities in the bladder mucosa. The entire lining of the urinary tract, or urothelium, is at risk because carcinomatous changes can occur in the mucosa of the bladder, kidney pelvis, ureter, and urethra.

A simple cystectomy or a radical cystectomy is performed for invasive or multifocal bladder cancer. Radical cystectomy in men involves removal of the bladder, prostate, and seminal vesicles and immediate adjacent perivesical tissues. In women, radical cystectomy involves removal of the bladder, lower ureter, uterus, fallopian tubes, ovaries, anterior vagina, and urethra. It may include removal of pelvic lymph nodes. Removal of the bladder requires a urinary diversion procedure, which is described later in this chapter.

Although radical cystectomy remains the standard of care for invasive bladder cancer, clinical trials are exploring trimodality therapy—transurethral resection of the bladder tumor, radiation, and chemotherapy—in an effort to spare patients the need for cystectomy (NCI, 2016). This approach to transitional cell bladder cancer mandates lifelong surveillance with periodic cystoscopy. Although most patients respond completely and their bladders remain free from invasive relapse, one fourth develop a relapse of noninvasive disease. This may be managed with transurethral resection of the bladder tumor and intravesical therapies but carries an additional risk that a late cystectomy may be required.

Pharmacologic Therapy

Chemotherapy with a combination of methotrexate, 5-fluorouracil, vinblastine (Velban), doxorubicin (Adriamycin), and cisplatin (Platinol) has been effective in producing partial remission of transitional cell carcinoma of the bladder in some patients. IV chemotherapy may be accompanied by radiation therapy (NCI, (2016). Topical chemotherapy (intravesical

chemotherapy or instillation of antineoplastic agents into the bladder, resulting in contact of the agent with the bladder wall) is considered when there is a high risk of recurrence, when cancer in situ is present, or when tumor resection has been incomplete. Topical chemotherapy delivers a high concentration of medication (thiotepa [Thioplex], doxorubicin, mitomycin [Mutamycin], and BCG Live) to the tumor to promote tumor destruction. Bladder cancer may also be treated by direct infusion of the cytotoxic agent through the bladder's arterial blood supply to achieve a higher concentration of the chemotherapeutic agent with fewer systemic toxic effects (NCI, 2016).

BCG Live is now considered the most predominant and conservative intravesical agent for recurrent bladder cancer, especially superficial transitional cell carcinoma, because it is an immunotherapeutic agent that enhances the body's immune response to cancer. BCG Live has a 43% advantage in preventing tumor recurrence, a significantly better rate than the 16% to 21% advantage of intravesical chemotherapy. In addition, BCG Live is particularly effective in the treatment of carcinoma in situ, eradicating it in more than 80% of cases. In contrast to intravesical chemotherapy, BCG Live has also been shown to decrease the risk of tumor progression. Although BCG Live treatment is the current standard of care, this treatment fails or is not tolerated in a significant proportion of patients (Askeland, Newton, O'Donnell, et al., 2012).

The optimal course of BCG Live appears to be a 6-week course of weekly instillations, followed by a 3-week course at 3 months for tumors that do not respond. In high-risk cancers, maintenance BCG Live given in a 3-week course at 6, 12, 18, and 24 months may limit recurrence and prevent progression. However, the adverse effects associated with this prolonged therapy may limit its widespread applicability.

The patient is allowed to eat and drink before the instillation procedure. Once the bladder is full, the patient must retain the intravesical solution for 2 hours before voiding. At the end of the procedure, the patient is encouraged to void and to drink liberal amounts of fluid to flush the medication from the bladder.

Radiation Therapy

Radiation of the tumor may be performed preoperatively to reduce microextension of the neoplasm and viability of tumor cells, thus decreasing the chances that the cancer may recur in the immediate area or spread through the circulatory or lymphatic systems. Radiation therapy is also used in combination with surgery or to control the disease in patients with inoperable tumors.

For more advanced bladder cancer or for patients with intractable hematuria (especially after radiation therapy), a large, water-filled balloon placed in the bladder produces tumor necrosis by reducing the blood supply of the bladder wall (hydrostatic therapy). The instillation of formalin, phenol, or silver nitrate relieves hematuria and strangury (slow and painful discharge of urine) in some patients.

URINARY DIVERSIONS

Urinary diversion procedures are performed to divert urine from the bladder to a new exit site, usually through a surgically created opening (stoma) in the skin. These procedures are primarily performed when a bladder tumor necessitates cystectomy (NCI, 2016). Urinary diversion has also been used in managing pelvic malignancy, birth defects, strictures, trauma to the ureters and urethra, neurogenic bladder, chronic infection causing severe ureteral and kidney damage, and intractable interstitial cystitis. It may also be used as a last resort in managing incontinence.

Controversy exists about the best method of establishing permanent diversion of the urinary tract. New techniques are frequently introduced in an effort to improve patient outcomes and quality of life. The age of the patient, condition of the bladder, body build, degree of obesity, degree of ureteral dilation, status of kidney function, and the patient's learning ability and willingness to participate in postoperative care are all taken into consideration when determining the appropriate surgical procedure.

The outcome for a patient with a urinary diversion depends to a large degree on the location or position of the stoma, whether the drainage device (pouch or bag) establishes a watertight seal to the skin, and the patient's ability to manage the pouch and drainage apparatus (Rubenwolf, Hampel, Roos, et al., 2016).

There are two types of urinary diversion. In a cutaneous urinary diversion, urine drains through an opening created in the abdominal wall and skin (see Fig. 45-8). In a **continent urinary diversion**, a portion of the intestine is used to create a new reservoir for urine (see Fig. 45-9A).

Cutaneous Urinary Diversions

Ileal Conduit

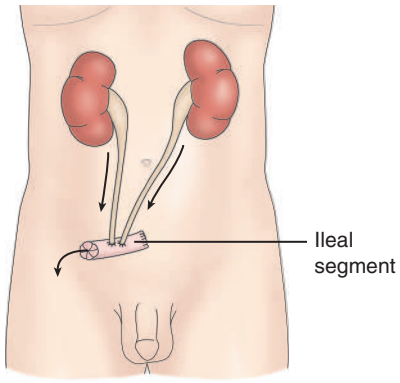
The ileal conduit (ileal loop) is the oldest and most common of the urinary diversion procedures in use because of the low number of complications and surgeons' familiarity with the procedure. In an ileal conduit, the urine is diverted by implanting the ureter into a 12-cm loop of ileum that is led out through the abdominal wall. This loop of ileum is a simple conduit (passageway) for urine from the ureters to the surface. A loop of the sigmoid colon may also be used (Rubenwolf et al., 2016). An ileostomy bag is used to collect the urine. The resected (cut) ends of the remaining intestine are anastomosed (connected) to provide an intact bowel.

Stents, usually made of thin, pliable tubing, are placed in the ureters to prevent occlusion secondary to postsurgical edema. The bilateral ureteral stents allow urine to drain from the kidney to the stoma and provide a method for accurate measurement of urine output. They may be left in place 10 to 21 days postoperatively. Jackson–Pratt drains or other types of drains are inserted to prevent the accumulation of fluid in the space created by removal of the bladder.

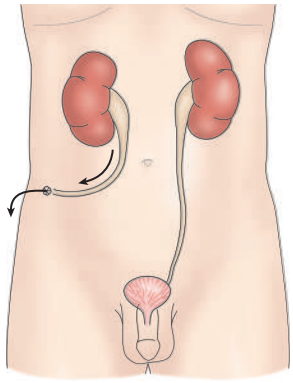
After surgery, a skin barrier and a transparent, disposable urinary drainage bag are applied around the conduit and connected to drainage. A custom-cut appliance is used until the edema subsides and the stoma shrinks to normal size. The clear bag allows the stoma to be inspected and the patency of the stent and the urine output to be monitored. The ileal bag drains urine (not feces) continuously. The appliance (bag) usually remains in place as long as it is watertight; it is changed when necessary to prevent leakage of urine.

Complications

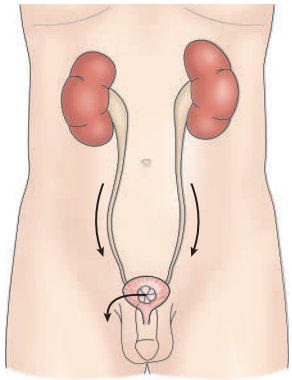
Complications that may follow placement of an ileal conduit include wound infection or wound dehiscence, urinary leakage, ureteral obstruction, hyperchloremic acidosis, small bowel obstruction, ileus, and gangrene of the stoma. Delayed complications include ureteral obstruction, contraction or narrowing of the stoma (stenosis), kidney deterioration due



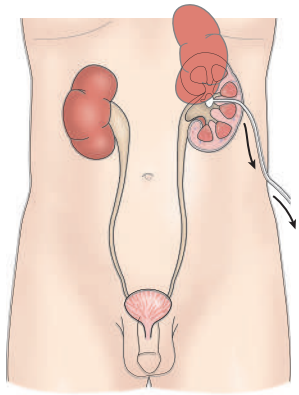
A Conventional ileal conduit.
The surgeon transplants the ureters to an isolated section of the terminal ileum (ileal conduit), bringing one end to the abdominal wall. The ureter may also be transplanted into the transverse sigmoid colon (colon conduit) or proximal jejunum (jejunal conduit).



B Cutaneous ureterostomy.
The surgeon brings the detached ureter through the abdominal wall and attaches it to an opening in the skin.

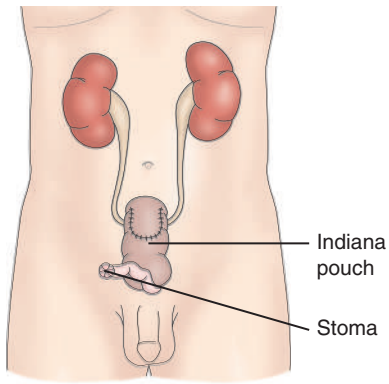


C Vesicostomy.
The surgeon sutures the bladder to the abdominal wall and creates an opening (stoma) through the abdominal and bladder walls for urinary drainage.

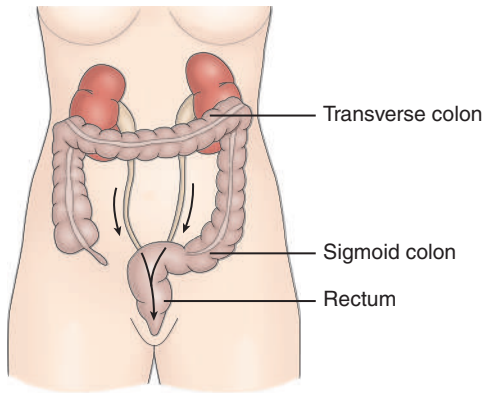


D Nephrostomy.
The surgeon inserts a catheter into the renal pelvis via an incision in the flank or by percutaneous catheter placement into the kidney.

Figure 45-8 • Types of cutaneous diversions include the conventional ileal conduit (**A**), cutaneous ureterostomy (**B**), vesicostomy (**C**), and nephrostomy (**D**).



A Indiana pouch.
The surgeon introduces the ureters into a segment of ileum and cecum. Urine is drained periodically by inserting a catheter into the stoma.



B Ureterosigmoidostomy.
The surgeon introduces the ureters into the sigmoid colon, thereby allowing urine to flow through the colon and out of the rectum.

Figure 45-9 • Types of continent urinary diversions include the Indiana pouch (**A**) and ureterosigmoidostomy (**B**).

to chronic reflux, pyelonephritis, renal calculi, and cancer recurrence (Rubenwolf et al., 2016); (Smolar, Salemi, Horst, et al., 2016).

Nursing Management

In the immediate postoperative period, urine volumes are monitored hourly. Throughout the patient's hospitalization, the nurse monitors closely for complications, reports signs and symptoms of them promptly, and intervenes quickly to prevent their progression.

A urine output below 0.5 mL/kg/hr may indicate dehydration or an obstruction in the ileal conduit, with possible backflow or leakage from the ureteroileal anastomosis. A catheter may be inserted through the urinary conduit to monitor the patient for possible stasis or residual urine from a constricted stoma. Urine may drain through the bilateral ureteral stents as well as around the stents. If the ureteral stents are not draining, the nurse may be instructed to carefully irrigate with 5 to 10 mL sterile normal saline solution, being careful not to exert tension that could dislodge the stent. Hematuria may be noted in the first 48 hours after surgery but usually resolves spontaneously.

Providing Stoma and Skin Care

Because the patient requires specialized care, a consultation is initiated with a ET nurse. The stoma is inspected frequently for color and viability. A healthy stoma is pink or red. A change from this normal color to purple, brown, or black suggests that the vascular supply may be compromised. If cyanosis and a compromised blood supply persist, surgical intervention may be necessary. The stoma is not sensitive to touch, but the skin around the stoma becomes sensitive if urine or the appliance causes irritation. The skin is inspected for (1) signs of irritation and bleeding of the stoma mucosa, (2) encrustation and skin irritation around the stoma (from alkaline urine coming in contact with exposed skin), and (3) wound infections (Dukes, Lowther, Martin, et al., 2013).

Testing Urine and Caring for the Ostomy

Moisture in bed linens or clothing or the odor of urine around the patient should alert the nurse to the possibility of leakage from the appliance, potential infection, or a problem in hygienic management. Because severe alkaline encrustation can accumulate rapidly around the stoma, the urine pH is kept below 6.5 by administration of ascorbic acid by mouth. Urine pH is determined by testing the urine draining from the stoma, not from the collecting appliance. A properly fitted appliance is essential to prevent exposure of the skin around the stoma to urine. If the urine is foul smelling, the stoma is catheterized, if prescribed, to obtain a urine specimen for culture and sensitivity testing.

Encouraging Fluids and Relieving Anxiety

Because mucous membrane is used in forming the conduit, the patient may excrete a large amount of mucus mixed with urine. This causes anxiety in many patients. To help relieve this anxiety, the nurse reassures the patient that this is a normal occurrence after an ileal conduit procedure. The nurse encourages adequate fluid intake to flush the ileal conduit and decrease the accumulation of mucus.

Selecting the Ostomy Appliance

Various urine collection appliances are available, and the nurse is instrumental (often with consultation with an ET nurse) in selecting an appropriate one. The urinary appliance may consist of one or two pieces and may be disposable (usually used once and discarded) or reusable. The choice of appliance is determined by the location of the stoma and by the patient's normal activity, manual dexterity, visual function, body build, economic resources, and preference.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

Patient education begins in the hospital but continues in the home setting because patients are usually discharged within days of surgery. The nurse instructs the patient how to assess and manage the urinary diversion as well as how to deal with changes in body image. An ET nurse is invaluable in consulting with the nurse on various aspects of care and patient education.

Changing the Appliance

The patient and family are educated about how to apply and change the appliance so that they are comfortable carrying out the procedure and can do so proficiently. Ideally, the appliance system is changed before the system leaks and at a time that is convenient for the patient. Many patients find that early morning is most convenient because the urine output is reduced. A variety of appliances are available; an average collecting appliance lasts 3 to 7 days before leakage occurs.

Regardless of the type of appliance used, a skin barrier is essential to protect the skin from irritation and excoriation. To maintain skin integrity, a skin barrier or leaking pouch is never patched with tape to prevent accumulation of urine under the skin barrier or faceplate. The patient is instructed to avoid moisturizing soaps and body washes when cleaning the area because they interfere with the adhesion of the pouch. The degree to which the stoma protrudes is not the same in all patients; thus, there are various accessories and custom-made appliances to solve individual problems. Patient guidelines for applying reusable and disposable systems are presented in Chart 45-14.

Controlling Odor

The patient is instructed to avoid foods that give the urine a strong odor (e.g., asparagus, cheese, eggs). Most appliances contain odor barriers, but, if needed, a few drops of liquid deodorizer or diluted white vinegar may be introduced through the drain spout into the bottom of the pouch with a syringe or eyedropper to reduce odors. Ascorbic acid by mouth helps acidify the urine and suppress urine odor. Patients should be cautioned not to put aspirin tablets in the pouch to control odor, because they may ulcerate the stoma. In addition, the patient is reminded that odor will develop if the pouch is worn longer than recommended and not cared for properly.

Managing the Ostomy Appliance

The patient is instructed to empty the pouch by means of a drain valve when it is one third full because the weight of more urine will cause the pouch to separate from the skin. Some patients prefer wearing a leg bag attached with an adapter to the drainage apparatus. To promote uninterrupted sleep, a collecting bottle and tubing (one unit) are snapped onto an adapter that connects to the ileal appliance. A small amount of urine is left in the bag when the adapter is attached to prevent the bag from collapsing against itself. The tubing may be threaded down the pajama or pants leg to prevent kinking. The collecting bottle and tubing are rinsed daily with cool water and once a week with a 3:1 solution of water and white vinegar.

Chart 45-14 PATIENT EDUCATION

Using Urinary Diversion Collection Appliances

Applying a Reusable Pouch System

The nurse instructs the patient to:

1. Gather all necessary supplies.
2. Prepare new appliance according to the manufacturer's directions:
   - Apply double-faced adhesive disc that has been properly sized to fit the reusable pouch faceplate.
   - Remove paper backing and set pouch aside, or apply thin layer of contact cement to one side of the reusable pouch faceplate.
   - Set pouch aside.
3. Remove soiled pouch gently. Lay aside to clean later.
4. Clean peristomal skin (skin around stoma) with small amount of soap and water. Rinse thoroughly and dry. If a film of soap remains on the skin and the site does not dry, the appliance will not adhere adequately.
5. Use a wick (rolled gauze pad or tampon) over the stoma to absorb urine and keep the skin dry throughout the appliance change.
6. Inspect peristomal skin for irritation.
7. Note that a skin protector wipe or barrier ring may be applied before centering the faceplate opening directly over the stoma.
8. Position appliance over stoma, and press gently into place.
9. If desired, use a pouch cover or apply cornstarch under the pouch to prevent perspiration and skin irritation.
10. Clean soiled pouch, and prepare for reuse.

Applying a Disposable Pouch System

The nurse instructs the patient to:

1. Gather all necessary supplies.
2. Measure stoma, and prepare an opening in the skin barrier about 1/8-inch larger than the stoma and the same shape as the stoma.
3. Remove paper backing from skin barrier, and set aside.
4. Gently remove old appliance, and set aside.
5. Clean peristomal skin with warm water, and dry thoroughly.
6. Inspect peristomal skin (skin around stoma) for irritation.
7. Use a wick (rolled gauze pad or tampon) over the stoma to absorb urine, and keep the skin dry during the appliance change.
8. Center opening of skin barrier over stoma, and apply with firm, gentle pressure to attain a watertight seal.
9. If using a two-piece system, snap pouch onto the flanged wafer that adheres to skin.
10. Close drainage tap or spout at bottom of pouch.
11. Note that a pouch cover can be used or cornstarch applied under pouch to prevent perspiration and skin irritation.
12. Apply hypoallergenic tape around the skin barrier in a picture-frame manner.
13. Dispose of soiled appliance.

Adapted from Dukes, S., Lowther, C., Martin, T., et al. (2013). Guidelines for standardizing the treatment of stoma granulomas at the mucocutaneous junction. World Council of Enterostomal Therapists Journal, 33(1), 12–15.

Cleaning and Deodorizing the Appliance

Usually, the reusable appliance is rinsed in warm water and soaked in a 3:1 solution of water and white vinegar or a commercial deodorizing solution for 30 minutes. It is rinsed with tepid water and air-dried away from direct sunlight. (Hot water and exposure to direct sunlight dry the pouch and increase the incidence of cracking.) After drying, the appliance may be powdered with cornstarch and stored. Two appliances are necessary—one to be worn while the other is air-drying.

Continuing and Transitional Care

Follow-up care is essential to determine how the patient has adapted to the altered body image and lifestyle changes. Referral for home care is indicated to determine how well the patient and family are coping with the urinary drainage diversion. The nurse assesses the patient's physical status and emotional response. In addition, the nurse assesses the ability of the patient and family to manage the urinary diversion and appliance, reinforces previous education, and provides additional information (e.g., community resources, sources of ostomy supplies, insurance coverage for supplies).

As the postoperative edema subsides, the nurse assists in determining the appropriate changes needed in the ostomy appliance. The size of the stoma is measured every 3 to 6 weeks for the first few months postoperatively. The correct appliance size is determined by measuring the widest part of the stoma with a ruler. The permanent appliance should be no more than 1.6 mm (1/8 inch) larger than the diameter of the stoma and the same shape as the stoma to prevent contact of the skin with drainage.

Cutaneous Ureterostomy

A cutaneous ureterostomy (see Fig. 45-8), in which the ureters are directed through the abdominal wall and attached to an opening in the skin, is used for selected patients with ureteral obstruction (i.e., advanced pelvic cancer) because it requires less extensive surgery than other urinary diversion procedures. It is also an appropriate procedure for patients who have had previous abdominal irradiation.

A urinary appliance is fitted immediately after surgery. The management of the patient with a cutaneous ureterostomy is similar to the care of the patient with an ileal conduit, although the stomas are usually flush with the skin or retracted.

Continent Urinary Diversions

Continent Ileal Urinary Reservoir (Indiana Pouch)

The most common continent urinary diversion is the Indiana pouch, created for the patient whose bladder is removed or no longer functions. The Indiana pouch uses a segment of the ileum and cecum to form the reservoir for urine (see Fig. 45-9A). The ureters are tunneled through the muscular bands of the intestinal pouch and anastomosed. The reservoir is made continent by narrowing the efferent portion of the ileum and sewing the terminal ileum to the subcutaneous tissue, forming a continent stoma flush with the skin. The pouch is sewn to the anterior abdominal wall around a cecostomy tube. Urine collects in the pouch until a catheter is inserted and the urine is drained.

The pouch must be drained at regular intervals by a catheter to prevent absorption of metabolic waste products from the urine, reflux of urine to the ureters, and UTI. Postoperative nursing care of the patient with a continent ileal urinary pouch is similar to nursing care of the patient with an ileal conduit. However, these patients usually have additional drainage tubes (cecostomy catheter from the pouch, stoma catheter exiting from the stoma, ureteral stents, and Penrose drain, as well

as a urethral catheter). All drainage tubes must be carefully monitored for patency and amount and type of drainage. In the immediate postoperative period, the cecostomy tube is irrigated two or three times daily to remove mucus and prevent blockage.

Other variations of continent urinary reservoirs are used occasionally (Crawshaw, Williams, & Woodhouse, 2014). With these methods, the pouch must be drained at regular intervals by inserting a catheter.

The procedural guidelines for draining a continent ileostomy are discussed in Procedure Guideline 45-1.

Ureterosigmoidostomy

Ureterosigmoidostomy, another form of continent urinary diversion, is a transplantation of the ureters into the sigmoid colon, allowing urine to flow through the colon and out the rectum (see Fig. 45-9B). It is usually performed in patients who have had extensive pelvic irradiation, previous small bowel resection, or coexisting small bowel disease.

After surgery, voiding occurs from the rectum (for life), and an adjustment in lifestyle will be necessary because of urinary frequency. Drainage has a consistency equivalent to watery diarrhea, and the patient has some degree of nocturia. Patients usually need to plan activities around the frequent need to urinate, which in turn may affect the patient's social life. However, patients have the advantage of urinary control without having to wear an external appliance.

Nursing Management

In addition to the usual preoperative regimen, the patient may be placed on a liquid diet for several days preoperatively to reduce residue in the colon. Antibiotic agents (neomycin, kanamycin) are given to disinfect the bowel. Ureterosigmoidostomy requires a competent anal sphincter, adequate kidney function, and

Procedural Guidelines 45-1

Draining a Continent Ileostomy (Kock Pouch)

A continent ileostomy is the surgical creation of a pouch of small intestine that can serve as an internal receptacle for fecal and urinary discharge; a nipple valve is constructed at the outlet. Postoperatively, a catheter extends from the stoma and is attached to a closed drainage suction system. To ensure patency of the catheter, 10–20 mL of normal saline is instilled gently into the pouch usually every 3 hours; return flow is not aspirated but is allowed to drain by gravity.

After approximately 2 weeks, when the healing process has progressed to the point at which the catheter is removed from the stoma, the patient is taught to drain the pouch. A catheter is inserted into the reservoir to drain the fluid. The length of time between drainage periods is gradually increased until the reservoir needs to be drained only every 4–6 hours and irrigated once each day. A pouch is not necessary; instead, most patients wear a small dressing over the opening.

When the fecal discharge is thick, water can be injected through the catheter to loosen and soften it. The consistency of the effluent is affected by food intake. At first, drainage is only 60–80 mL, but as time goes on, the amount increases significantly. The internal Kock pouch stretches, eventually accommodating 500–1000 mL. The patient learns to use the sensation of pressure in the pouch as a gauge to determine how often the pouch should be drained.

The following procedure is used to drain the pouch; the patient is helped to participate in this procedure to learn to perform it unassisted.

Equipment

- Catheter
- Tissues
- Water-soluble lubricant
- Gauze squares
- Syringe
- Irrigating solution in a bowl
- Emesis or receiving basin

Implementation

Nursing Actions	Rationale
1. Perform hand hygiene	1. Hand hygiene is necessary before any intervention to decrease the likelihood of transmitting a hospital associated infection.
2. Lubricate the catheter and gently insert it about 5 cm (2 inches), at which point some resistance may be felt at the valve or nipple.	2. When gentle pressure is used, the catheter usually enters the pouch.
3. If there is much resistance, fill a syringe with 20 mL of air or water and inject it through the catheter, while still exerting some pressure on the catheter.	3. This permits the catheter to enter the pouch.
4. Place the other end of the catheter in a drainage basin held below the level of the stoma. Later, this process can be carried out at the toilet with drainage delivered into the toilet bowl.	4. Gravity facilitates drainage. Drainage may include flatus as well as effluent.
5. After drainage, the catheter is removed and the area around the stoma is gently washed with warm water. Pat dry and apply an absorbent pad over the stoma. Fasten the pad with hypoallergenic tape.	5. The entire procedure requires about 5–10 minutes; at first, it is performed every 3 hours. The time between procedures is gradually lengthened until irrigation is only required once daily.

Adapted from Chapman, G. M., Sinclair, L., & Langevin, J. M. (2009).Ileoanal reservoir guide. United Ostomy Associations of America: Author.

active renal peristalsis. The degree of anal sphincter control may be determined by assessing the patient's ability to retain enemas.

The postoperative regimen initially includes placing a catheter in the rectum to drain the urine and prevent reflux of urine into the ureters and kidneys. The tube is taped to the buttocks, and special skin care is given around the anus to prevent excoriation. Irrigations of the rectal tube may be prescribed, but force is never used because of the danger of introducing bacteria into the newly implanted ureters.

Monitoring Fluid and Electrolytes

In ureterosigmoidostomy, larger areas of the bowel mucosa are exposed to urine and electrolyte reabsorption. As a result, electrolyte imbalance and acidosis may occur. Potassium and magnesium in the urine may cause diarrhea. Fluid and electrolyte balance is maintained in the immediate postoperative period by closely monitoring the serum electrolyte levels and administering appropriate IV fluids. Acidosis may be prevented by placing the patient on a low-chloride diet supplemented with sodium potassium citrate.

The patient should be instructed never to wait longer than 2 to 3 hours before emptying urine from the intestine. This keeps rectal pressure low and minimizes the absorption of urinary constituents from the colon. It is essential to educate the patient about the symptoms of UTI: fever, flank pain, urgency, and frequency.

Retraining the Anal Sphincter

After the rectal catheter is removed, the patient learns to control the anal sphincter through special sphincter exercises. At first, urination is frequent. With reassurance and encouragement and the passage of time, the patient gains greater control and learns to differentiate between the need to void and the need to defecate.

Promoting Dietary Measures

Specific dietary instructions include avoidance of gas-forming foods (flatus can cause stress incontinence and offensive odors). Other ways to avoid gas are to avoid chewing gum, smoking, and any other activity that involves swallowing air. Salt intake may be restricted to prevent hyperchloremic acidosis. Potassium intake is increased through foods and medication because potassium may be lost in acidosis.

Monitoring and Managing Potential Complications

Pyelonephritis (upper UTI) due to reflux of bacteria from the colon is fairly common. Long-term antibiotic therapy may be prescribed to prevent infection. A late complication is adenocarcinoma of the sigmoid colon, possibly from cellular changes due to exposure of the colonic mucosa to urine. Urinary carcinogens promote late malignant transformation of the colon after a ureterosigmoidostomy, warranting lifelong medical follow-up.

Other Urinary Diversion Procedures

Variations in urinary diversion surgical procedures are devised frequently in an effort to identify and perfect procedures that will improve patient outcomes and reduce the incidence of postoperative problems (Rubenwolf et al., 2016). These include cecal, patched cecal, and Mainz reservoirs. These techniques involve isolating a part of the large intestine to form a reservoir for urine and creating an abdominal stoma. Another surgical procedure, the Camey procedure, uses a portion of the ileum as a bladder substitute. In this procedure, the isolated ileum serves as the reservoir for urine; it is anastomosed directly to the portion of the remaining urethra after cystectomy. This procedure permits emptying of the bladder through the urethra. However, the Camey procedure applies only to men because the entire urethra is removed when a cystectomy is performed in women.

NURSING PROCESS

The Patient Undergoing Urinary Diversion Surgery

Preoperative Assessment

The following are key preoperative nursing assessment concerns:

- Cardiopulmonary function assessments are performed because patients undergoing cystectomy are often older adults who may be at greater risk for cardiac and respiratory complications.
- A nutritional status assessment is important because of possible poor nutritional intake related to underlying health problems.
- Learning needs are assessed in consultation with an ET nurse to evaluate the patient's and the family's understanding of the procedure as well as the changes in physical structure and function that result from the surgery. The patient's self-concept and self-esteem are assessed in addition to methods for coping with stress and loss. The patient's mental status, manual dexterity and coordination, vision, and preferred method of learning are noted because they affect postoperative self-care.

Preoperative Diagnosis

Nursing Diagnoses

Based on the assessment data, preoperative nursing diagnoses may include the following:

- Anxiety related to anticipated losses associated with the surgical procedure
- Imbalanced nutrition: less than body requirements related to inadequate nutritional intake
- Deficient knowledge about the surgical procedure and postoperative care

Preoperative Planning and Goals

The major goals for the patient may include relief of anxiety; improved preoperative nutritional status; and increased knowledge about the surgical procedure, expected outcomes, and postoperative care.

Preoperative Nursing Interventions

Relieving Anxiety

The threat of cancer and removal of the bladder create anxiety related to changes in body image. Patients may face problems adapting to an external appliance, a stoma, a surgical incision, and altered toileting habits. Men must also adapt to sexual impotency; a penile implant is considered if the patient is a candidate for the procedure. Women also have anxiety related to altered appearance, body image, and self-esteem. A supportive approach, both physical and psychosocial, is needed and includes assessing the patient's self-concept and manner of coping with stress and loss; helping the patient to identify ways to maintain their lifestyle and independence with as few

changes as possible; and encouraging the patient to express fears and anxieties about the ramifications of the upcoming surgery.

Ensuring Adequate Nutrition

A low-residue diet is prescribed to cleanse the bowel to minimize fecal stasis, decompress the bowel, and minimize postoperative ileus. In addition, antibiotic medications are given to reduce pathogenic flora in the bowel and to reduce the risk of infection. Because the patient undergoing a urinary diversion procedure for cancer may be severely malnourished due to the tumor, previous treatments, and anorexia, enteral or parenteral nutrition may be prescribed to promote healing. Adequate preoperative hydration is imperative to ensure urine flow during surgery and to prevent hypovolemia during the prolonged surgical procedure.

Explaining Surgery and Its Effects

Participation of an ET nurse in patient education and care, is invaluable for informed preoperative education and postoperative planning. Explanations of the surgical procedure, the appearance of the stoma, the rationale for preoperative bowel preparation, the reasons for wearing a collection device, and the anticipated effects of the surgery on sexual functioning are part of patient education. The placement of the stoma site is planned preoperatively with the patient standing, sitting, and lying down to locate the stoma away from bony prominences, skin creases, and folds. The stoma should also be placed away from old scars, the umbilicus, and the belt line.

For ease of self-care, the patient must be able to see and reach the site comfortably. The site is marked with indelible ink so that it can be located easily during surgery. The patient is assessed for allergies or sensitivity to tape or adhesives. Patch testing of certain appliances may be necessary before the ostomy equipment is selected. This is particularly important if the patient is or may be allergic to latex (see Chapter 4; Figure 4-1).

Preoperative Evaluation

To measure the effectiveness of care, the nurse evaluates the patient's preoperative anxiety level and nutritional status as well as pre-existing knowledge and expectations of surgery.
Expected patient outcomes may include:

1. Exhibits reduced anxiety about surgery and expected losses
   a. Verbalizes fears with health care team and family
   b. Expresses positive attitude about outcome of surgery
2. Exhibits adequate nutritional status
   a. Maintains adequate intake before surgery
   b. Maintains body weight
   c. States rationale for enteral or parenteral nutrition if needed
   d. Exhibits normal skin turgor, moist mucous membranes, adequate urine output, and absence of excessive thirst
3. Demonstrates knowledge about the surgical procedure and postoperative course
   a. Identifies limitations expected after surgery
   b. Discusses expected immediate postoperative environment (tubes, equipment, nursing surveillance)
   c. Practices deep-breathing, coughing, and foot exercises

Postoperative Assessment

The role of the nurse in the immediate postoperative period is to prevent complications and to assess the patient carefully for any signs and symptoms of complications. The catheters and any drainage devices are monitored closely. Urine volume, patency of the drainage system, and color of the drainage are assessed. A sudden decrease in urine volume or increase in drainage is reported promptly to the primary provider, because these may indicate obstruction of the urinary tract, inadequate blood volume, or bleeding. In addition, the patient's need for pain control is assessed regularly, as with all postoperative patients.

Postoperative Diagnosis

Nursing Diagnoses

Based on the assessment data, major postoperative nursing diagnoses may include the following:

- Risk for impaired skin integrity related to problems in managing the urine collection appliance
- Acute pain related to surgical incision
- Disturbed body image related to urinary diversion
- Ineffective sexuality pattern related to structural and physiologic alterations
- Deficient knowledge about management of urinary function

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Peritonitis due to disruption of anastomosis
- Stoma ischemia and necrosis due to compromised blood supply to stoma
- Stoma retraction and separation of mucocutaneous border due to tension or trauma

Postoperative Planning and Goals

The major goals for the patient may include maintaining skin integrity, relieving pain, increasing self-esteem, developing appropriate coping mechanisms to accept and deal with altered urinary function and sexuality, increasing knowledge about management of urinary function, and preventing potential complications.

Postoperative Nursing Interventions

Postoperative management focuses on monitoring urinary function, preventing postoperative complications (infection and sepsis, respiratory complications, fluid and electrolyte imbalances, fistula formation, and urine leakage), and promoting patient comfort. Catheters or drainage systems are monitored, and urine output is monitored carefully. A nasogastric tube is inserted during surgery to decompress the GI tract and to relieve pressure on the intestinal anastomosis. It is usually kept in place for several days after surgery. As soon as bowel function resumes—as indicated by bowel sounds, the passage of flatus, and a soft abdomen—oral fluids are permitted. Until that time, IV fluids and electrolytes are given. The patient is assisted to ambulate as soon as possible to prevent complications of immobility.

Maintaining Skin Integrity

Strategies to promote skin integrity begin with reducing and controlling those factors that increase the patient's risk of poor nutrition and poor healing. Meticulous skin care and management of the drainage system are provided by the nurse until the patient can manage them and is comfortable doing so. Care is taken to keep the system intact to protect the skin from exposure to drainage. Supplies must be readily available to manage the drainage in the immediate postoperative period. Consistency in implementing the skin care program throughout the postoperative period results in maintenance of skin integrity and patient comfort. In addition, maintenance of skin integrity

around the stoma enables the patient and family to adjust more easily to the alterations in urinary function and helps them learn skin care techniques.

Relieving Pain

Analgesic medications are given liberally postoperatively to relieve pain and promote comfort, thereby allowing the patient to turn, cough, and perform deep-breathing exercises. Patient-controlled analgesia and regular administration of analgesic agents around the clock are two options that may be used to ensure adequate pain relief. A pain intensity scale is used to evaluate the adequacy of the medication and the approach to pain management. See Chapter 9 for further discussion of pain management.

Improving Body Image

The patient's ability to cope with the changes associated with the surgery depends to some degree on their body image and self-esteem before the surgery and the support and reaction of others. Allowing the patient to express concerns and anxious feelings can help, especially in adjusting to the changes in toileting habits. The nurse can also help improve the patient's self-concept by educating about skills needed to be independent in managing the urinary drainage devices. Education about ostomy care is conducted in a private setting to encourage the patient to ask questions without fear of embarrassment. Explaining why the nurse must wear gloves when performing ostomy care can prevent the patient from misinterpreting the use of gloves as a sign of aversion to the stoma.

Exploring Sexuality Issues

Patients who experience altered sexual function as a result of the surgical procedure may mourn this loss. One study of 82 patients reported that sexual function in all domains was negatively affected in both genders (Rubenwolf et al., 2016). Encouraging the patient and partner to share their feelings about this loss with each other and acknowledging the importance of sexual function and expression may encourage the patient and partner to seek sexual counseling and to explore alternative ways of expressing sexuality. A visit from another patient with an ostomy who is functioning fully in society and family life may also assist the patient and family in recognizing that full recovery is possible.

Monitoring and Managing Potential Complications

Complications are not unusual because of the complexity of the surgery, the underlying reason (cancer, trauma) for the urinary diversion procedure, and the patient's frequently less-than-optimal nutritional status. Complications may include respiratory disorders (e.g., atelectasis, pneumonia), fluid and electrolyte imbalances, breakdown of any anastomosis, sepsis, fistula formation, fecal or urine leakage, and skin irritation. If these occur, the patient will remain hospitalized for an extended length of time and will probably require parenteral nutrition, GI decompression by means of nasogastric suction, and further surgery. The goals of management are to establish drainage, provide adequate nutrition for healing to occur, and prevent sepsis.

Peritonitis. Peritonitis can occur postoperatively if urine leaks at the anastomosis. Signs and symptoms include abdominal pain and distention, muscle rigidity with guarding, nausea and vomiting, paralytic ileus (absence of bowel sounds), fever, and leukocytosis.

Urine output must be monitored closely, because a sudden decrease in output with a corresponding increase in drainage from the incision or drains may indicate urine leakage. In addition, the urine drainage device is observed for leakage. The pouch is changed if a leak is observed. Small leaks in the anastomosis may seal themselves, but surgery may be needed for larger leaks.

Vital signs (blood pressure, pulse and respiratory rates, temperature) are monitored. Changes in vital signs, as well as increasing pain, nausea and vomiting, and abdominal distention, are reported and may indicate peritonitis.

Stoma Ischemia and Necrosis. The stoma is monitored because ischemia and necrosis of the stoma can result from tension on the mesentery blood vessels, twisting of the bowel segment (conduit) during surgery, or arterial insufficiency. The new stoma must be inspected at least every 4 hours to assess the adequacy of its blood supply. The stoma should be red or pink. If the blood supply to the stoma is compromised, the color changes to purple, brown, or black. These changes are reported immediately. The surgeon or ET nurse may insert a small, lubricated tube into the stoma and shine a flashlight into the lumen of the tube to assess for superficial ischemia or necrosis. A necrotic stoma requires surgical intervention. If the ischemia is superficial, the dusky stoma is observed and may slough its outer layer in several days.

Stoma Retraction and Separation. Stoma retraction and separation of the mucocutaneous border can occur as a result of trauma or tension on the internal bowel segment used for creation of the stoma. In addition, mucocutaneous separation can occur if the stoma does not heal as a result of accumulation of urine on the stoma and mucocutaneous border. Using a collection drainage pouch with an antireflux valve is helpful because the valve prevents urine from pooling on the stoma and mucocutaneous border. Meticulous skin care to keep the area around the stoma clean and dry promotes healing. If a separation of the mucocutaneous border occurs, surgery is not usually needed. The separated area is protected by applying karaya powder, stoma adhesive paste, and a properly fitted skin barrier and pouch. By protecting the separation, healing is promoted. If the stoma retracts into the peritoneum, surgical intervention is mandatory.

If surgery is needed to manage these complications, the nurse provides explanations to the patient and family. The need for additional surgery is usually perceived as a setback by the patient and family. Emotional support of the patient and family is provided along with physical preparation of the patient for surgery.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care. A major postoperative objective is to assist the patient to achieve the highest level of independence and self-care possible. The nurse and ET nurse work closely with the patient and family to instruct and assist them in all phases of managing the ostomy. Adequate supplies and complete instruction are necessary to enable the patient and a family member to develop competence and confidence in their skills. Written and verbal instructions are provided, and the patient is encouraged to contact the nurse or primary provider with follow-up questions. Follow-up telephone calls from the nurse to the patient and family after discharge may provide added support and provide another opportunity to answer their questions. Follow-up visits and reinforcement of correct skin care and appliance management techniques also promote skin integrity. Specific techniques for managing the appliance are described in Chart 45-14.

The patient is encouraged to participate in decisions regarding the type of collecting appliance and the time of day to change the appliance. The patient is assisted and encouraged to look at and

touch the stoma early to overcome any fears. The patient and family need to know the characteristics of a normal stoma:

- Pink or red and moist, like the inside of the mouth
- Insensitive to pain because it has no nerve endings
- Vascular, which means it may bleed when cleaned

In addition, if a segment of the GI tract was used to create the urinary diversion, mucus may be visible in the urine. By learning what is normal, the patient and family become familiar with what signs and symptoms they should report and what problems they can handle themselves.

Information provided to the patient and the extent of involvement in self-care are determined by the patient's physical recovery and ability to accept and acquire the knowledge and skill needed for independence. Verbal and written instructions are provided, and the patient is given the opportunity to practice and demonstrate the knowledge and skills needed to manage urinary drainage.

Continuing and Transitional Care. Follow-up care is essential to determine how the patient has adapted to the changes in body image and lifestyle adjustments. Visits from a nurse are important to assess the patient's adaptation to the home setting and management of the ostomy. Education and reinforcement may assist the patient and family to cope with altered urinary function. It is important to assess for long-term complications that may occur, such as pouch leakage or rupture, stone formation, stenosis of the stoma, deterioration in kidney function, or incontinence.

Long-term monitoring for anemia is performed to identify vitamin B_{12} deficiency, which may occur when a significant portion of the terminal ileum is removed. This may take several years to develop and can be treated with vitamin B_{12} injections. The patient and family are informed about the Ostomy Associations of India (OAI) and any local ostomy support groups to provide ongoing support, assistance, and education.

Postoperative Evaluation

Expected patient outcomes may include:

1. Maintains skin integrity
   a. Maintains intact skin and demonstrates skill in managing drainage system and appliance
   b. States actions to take if skin excoriation occurs
2. Reports relief of pain
3. Exhibits improved body image as evidenced by the following:
   a. Voices acceptance of urinary diversion, stoma, and appliance
   b. Demonstrates increasingly independent self-care, including hygiene and grooming
   c. States acceptance of support and assistance from family members, health care providers, and another patient with an ostomy
4. Copes with sexuality issues
   a. Verbalizes concern about possible alterations in sexuality and sexual function
   b. Reports discussion of sexual concerns with partner and appropriate counselor
5. Demonstrates knowledge needed for self-care
   a. Performs self-care and proficient management of urinary diversion and appliance
   b. Asks questions relevant to self-management and prevention of complications
   c. Identifies signs and symptoms needing care from primary provider, nurse, or other health care providers
6. Absence of complications as evidenced by the following:
   a. Reports absence of pain or tenderness in abdomen
   b. Has temperature within normal range
   c. Reports no urine leakage from incision or drains
   d. Has urine output within desired volume limits
   e. Maintains stoma that is red or pink, moist, and appropriate in size without edema
   f. Has intact and healed border of the stoma

CRITICAL THINKING EXERCISES

1. You are caring for a patient in the intensive care unit who has had an indwelling urinary catheter inserted. What strategies should be used to avoid a CAUTI in the patient? Identify the factors that would put this patient at risk for CAUTI.
2. You are a nurse in a busy urology practice who often cares for patients with incontinence. Describe the major types of incontinence, and compare and contrast each. What are the evidence-based management techniques used in treating the different types of incontinence? How do practices differ for men and women? Identify the criteria used to evaluate the strength of the evidence for these practices.
3. A 55-year-old woman is admitted to a medical-surgical nursing unit with bladder cancer. She is scheduled for a radical cystectomy and urinary diversion. Identify the priorities, approach, and techniques you would use to provide care for this patient in the pre-operative phase of care. How will your priorities, approach, and techniques differ in the post-operative phase of care?

REFERENCES

*Asterisk indicates nursing research.

Books

Bader, M. K., Littlejohns, L. R., & Olson, D. M. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Booker, K. (2015). Critical care nursing: Monitoring and treatment for advanced nursing practice. Oxford: Wiley Blackwell.

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Eliopoulos, C. (2018). Gerontological Nursing (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Fischbach, F., & Dunning, M. B. (2015). A manual of laboratory and diagnostic tests (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Miller, C. A. (2015). Nursing for wellness in older adults (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

*Anderson, R., & Zinkgraf, K. (2013). Use and effectiveness of complementary therapies among women with interstitial cystitis. Urologic Nursing, 33(6), 306–309.

Askeland, E. J., Newton, M. R., O'Donnell, M. A., et al. (2012). Bladder cancer immunotherapy: BCG and beyond. Advances in Urology, 2012,

181987. Retrieved 12/13/2016 www.ncbi.nlm.nih.gov/pmc/articles/PMC388311/?tool=pubmed
*Bass-Ware, A., Weed, D., Johnson, T., et al. (2014). Evaluation of the effect of cranberry juice on symptoms associated with a urinary tract infection. Urologic Nursing, 34(3), 121–127.
Carter, N. M., Reitmeier, L., & Goodloe, L. R. (2014). An evidence-based approach to the prevention of catheter-associated urinary tract infections. Urologic Nursing, 34(5), 238–245.
Chisholm, A. H. (2015). Probiotics in preventing recurrent urinary tract infections in women: A literature review. Urologic Nursing, 35(1), 18–21, 29.
Crawshaw, A., Williams, J., & Woodhouse, F. (2014). The Kock pouch reconsidered: An alternative surgical technique. British Journal of Nursing, 23(17), S26–S29.
Cunningham, P., Noble, H., Al-Modhefer, A., et al. (2016). Kidney stones: Pathophysiology, diagnosis and management. British Journal of Nursing, 25(20), 1112–1116.
*Day, M. R., Leahy-Warren, P., Loughran, S., et al. (2014). Community-dwelling women's knowledge of urinary incontinence. British Journal of Community Nursing, 19(11), 534–538.
Dukes, S., Lowther, C., Martin, T., et al. (2013). Guidelines for standardising the treatment of stoma granulomas at the mucocutaneous junction. World Council of Enterostomal Therapists Journal, 33(1), 12–15.
Faridi, M. S., & Singh, K. S. (2020). Preliminary study of prevalence of urolithiasis in North-Eastern city of India. Journal of Family Medicine and Primary Care, 9(12), 5939–5943.
*Hagerty, T., Kertesz, L., Schmidt, J. M., et al. (2015). Risk factors for catheter associated urinary tract infections in critically ill patients with subarachnoid hemorrhage. Journal of Neuroscience Nursing, 47(1), 51–54.
Hallis, F., Amasyali, A.S., Yucak, A., et al. (2015). Intrathoracic kidney after blunt abdominal trauma: A case report and review of the literature. Case Reports in Urology, 2015, 1–3.
Hopkins, L., McCroskey, D., Reeves, G., et al. (2014). Implementing a urinary tract infection clinical practice guideline in an ambulatory urgent care practice. The Nurse Practitioner, 39(4), 50–54.
Kumari, A., Dokwal, S., Mittal, P., Kumar, R., Bansal, P., Kumar, H.D., & Bhutani, J. (2016). An increase incidence in uric acid nephrolithiasis: Changing pattern. Journal of Clinical Diagnostic Research, 10(7), B01–B03.
Matsuoka, P. K., Locali, R. F., Pacetta, A. M., et al. (2016). The efficacy and safety of urethral injection therapy for urinary incontinence in women: A systematic review. Clinics, 71(2), 94–100.
*McCooty, S., & Latthe, P. (2014). Electronic pelvic floor assessment questionnaire: A systematic review. British Journal of Nursing, 23(18), S32–S37.Mori, C. (2014). A-Voiding catastrophe: Implementing a nurse-driven protocol. MEDSURG Nursing, 23(1), 15–21, 28.
Narendranath, V., Nandakumar, B. S., Sarala, K.S. (2017). Epidemiology of hospital-acquired infections in a tertiary care teaching hospital in India: a cross-sectional study of 79401 inpatients. International Journal of Community Medicine and Public Health, 4(2), 335–339.
National Cancer Institute (NCI). (2016). Bladder cancer treatment (PDQ®)–Health professional version. Retrieved 12/13/2016 at: www.cancer.gov/types/bladder/hp/bladder-treatment-pdq#section/all.
National Centre For Disease Informatics & Research-Indian Council of Medical Research, (NCDIR-ICMR) Annual report, 2016-17. Retrieved on 17th May 2018 at http://www.ncdirindia.org/
Robinson, J. P., Bradway, C. W., Bunting-Perry, L., et al. (2013). Lower urinary tract symptoms in men with Parkinson's disease. Journal of Neuroscience Nursing, 45(6), 382–392.
Rubenwolf, P. C., Hampel, C., Roos, F., et al. (2016). Continent anal urinary diversion in Classic bladder exstrophy: 45-year experience. Urology,100:249–254.
Singh, B., Katiyar, D., Tilak, R., Srivastava, R. K. & Chauhan, R. S. (2018). Prevalence of Urinary Tract Infection Causing Microorganism and Determination of Susceptibility to Antibiotic among Slum Women of District Varanasi. International Journal of Current Microbiology and Applied Sciences, 7(02), 3483–3497.
Singh. U., Agarwal. P. & Shankwhar. P (2013). Prevalence and risk factors of urinary incontinence in Indian women: A hospital based survey. Indian Journal of Urology, 29(1), 31–36.
Smolar, J., Salemi, S., Horst, H., et al. (2016). Stem cells in functional bladder engineering. Transfusion Medicine and Hemotherapy 43, 328–335.
Strouse, A. (2015). Appraising the literature on bathing practices and catheter-associated urinary tract infection prevention. Urologic Nursing, 35(1), 11–17.
Wille, M. A., Zagaja, G. P., Shalhav, A. L., & Gundeti, M. S. (2011). Continence outcomes in patients undergoing robotic assisted laparoscopic Mitrofanoff appendicovesicostomy. Journal of Urology, 185(4), 1438–1443.

Resources

American Cancer Society (ACS), www.cancer.org
American Urological Association, www.auanet.org
National Association for Continence (NAFC), www.nafc.org
National Cancer Institute (NCI), www.cancer.gov
National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), National Institutes of Health, www.niddk.nih.gov
National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC), kidney.niddk.nih.gov/
National Kidney Foundation, www.kidney.org
Ostomy Association of India, http://www.ostomyindia.com/
Securicare-Living with Ostomy in India, http://www.securicaremedical.co.uk/blog/living-with-an-ostomy-in-india
India ostomy service-stomacare.co.in/

UNIT

XIV

Male Reproductive Function

Chapter 46 Assessment and Management of Patients with Male Reproductive Disorders 1469

CHAPTER 46

Assessment and Management of Patients with Male Reproductive Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe structures and function of the male reproductive system.
2. Discuss nursing assessment of the male reproductive system including climacteric changes; identify diagnostic tests used and their related nursing implications.
3. Explain the causes and management of male sexual dysfunction.
4. Compare the types of prostatectomy with regard to advantages and disadvantages.
5. Use the nursing process as a framework for care of the patient with prostate cancer or undergoing prostatectomy.
6. Identify the nursing management of patients with testicular cancer.
7. Compare and contrast the various disorders of the penis, including pathophysiology, clinical manifestations, and management.
8. Explain the features and causes of gynecomastia.

GLOSSARY

androgen deprivation therapy (ADT): surgical (orchiectomy) or medical castration (e.g., with luteinizing hormone–releasing hormone agonists)
benign prostatic hyperplasia (BPH): noncancerous enlargement or hypertrophy of the prostate; the most common pathologic condition in older men
brachytherapy: delivery of internal radiation therapy to a localized area of tissue
circumcision: excision of the foreskin, or prepuce, of the glans penis
cystostomy: surgical creation of an opening into the urinary bladder
epididymitis: infection of the epididymis that usually descends from an infected prostate or urinary tract; also may develop as a complication of gonorrhea, chlamydia, or *Escherichia coli*
erectile dysfunction: the inability to either achieve or maintain an erection sufficient to accomplish sexual intercourse; also called *impotence*
gynecomastia: abnormal tender breast mass development that occurs in males
hydrocele: a collection of fluid, generally in the tunica vaginalis of the testis, although it also may collect within the spermatic cord
orchiectomy: surgical removal of one or both of the testes
orchitis: acute inflammation of the testes (testicular congestion) caused by pyogenic, viral, spirochetal, parasitic, traumatic, chemical, or unknown factors
phimosis: condition in which the foreskin is constricted so that it cannot be retracted over the glans; can occur congenitally or from inflammation and edema
priapism: an uncontrolled, persistent erection of the penis from either neural or vascular causes, including medications, sickle cell thrombosis, leukemic cell infiltration, spinal cord tumors, and tumor invasion of the penis or its vessels
prostatectomy: surgical removal of the entire prostate, the prostate urethra, and the attached seminal vesicles plus the ampulla of the vas deferens
prostate-specific antigen (PSA): substance that is produced by the prostate gland; is used in combination with digital rectal examination to screen for prostate cancer
prostatitis: inflammation of the prostate gland caused by infectious agents (bacteria, fungi, mycoplasma) or various other problems (e.g., urethral stricture, prostatic hyperplasia)
retrograde ejaculation: during ejaculation, semen travels to the urinary bladder instead of exiting through the penis
spermatogenesis: production of sperm in the testes
testosterone: male sex hormone secreted by the testes; induces and preserves the male sex characteristics
transurethral resection of the prostate (TURP): resection of the prostate through endoscopy; the surgical and optical instrument is introduced directly through the urethra to the prostate, and the gland is then removed in small chips with an electrical cutting loop
varicocele: an abnormal dilation of the veins of the pampiniform venous plexus in the scrotum (the network of veins from the testis and the epididymis, which constitute part of the spermatic cord)
vasectomy: ligation and transection of part of the vas deferens, with or without removal of a segment of the vas, to prevent the passage of the sperm from the testes; also called *male sterilization*

Introduction

Disorders of the male reproductive system include a wide variety of conditions that usually affect both urinary and reproductive systems. Because these disorders involve the genitalia and often affect sexuality, the patient may experience anxiety and embarrassment. The nurse must be aware of the patient's need for privacy as well as his need for education and support. This requires an openness to discuss critical and sensitive issues with the patient, including his partner when appropriate, as well as effective assessment, management, and communication. Nurses must be comfortable when examining male genitalia and must recognize their own attitudes and perceptions about male reproductive disorders. Education of the patient and partner about treatment and self-care strategies is essential (Tabloski, 2014).

ASSESSMENT OF THE MALE REPRODUCTIVE SYSTEM

Anatomic and Physiologic Overview

In the male, several organs serve as parts of both the urinary tract and the reproductive system. Disorders in the male reproductive

organs may interfere with the functions of one or both of these systems. As a result, diseases of the male reproductive system are usually treated by a urologist. The structures in the male reproductive system include the (1) external male genitalia, consisting of the testes, epididymis, scrotum, and penis, and the (2) internal male genitalia, consisting of the vas deferens (ductus deferens), ejaculatory duct, and prostatic and membranous sections of the urethra, seminal vesicles, and certain accessory glands, such as the prostate gland and Cowper glands (bulbourethral glands) (see Fig. 46-1).

The testes have a dual function: spermatogenesis (production of sperm) and secretion of the male sex hormone testosterone, which induces and preserves the male sex characteristics. The testes are formed in the embryo, within the abdominal cavity near the kidney. During the last month of fetal life, they descend posterior to the peritoneum and pierce the abdominal wall in the groin. Later, they progress along the inguinal canal into the scrotal sac. In this descent, they are accompanied by blood vessels, lymphatics, nerves, and ducts, which support the tissue and make up the spermatic cord. This cord extends from the internal inguinal ring through the abdominal wall and the inguinal canal to the scrotum. As the testes descend into the scrotum in the final 2 to 3 months of gestation, a tubular extension of peritoneum accompanies them (Hall, 2015). Normally, this tissue is obliterated during fetal development; only the tunica vaginalis, which covers the testes, remains. If the peritoneal process remains open into the abdominal cavity, a potential sac remains into which abdominal contents may enter to form an indirect inguinal hernia.

The testes, or ovoid sex glands, are encased in the scrotum, which keeps them at a slightly lower temperature than the rest of the body to facilitate spermatogenesis (Hall, 2015). The testes consist of numerous seminiferous tubules in which the spermatozoa form. Collecting tubules transmit the spermatozoa into the epididymis, a hoodlike structure lying on the testes and containing winding ducts that lead into the vas deferens. This firm, tubular structure passes upward through the inguinal canal to enter the abdominal cavity behind the peritoneum. It then extends downward toward the base of the bladder. An out-pouching from this structure is the seminal vesicle, which acts as a reservoir for testicular secretions. The tract is continued as the ejaculatory duct, which passes through the prostate gland to enter the urethra. Testicular secretions take this pathway when they exit the penis during ejaculation.

The penis is the organ for both copulation and urination. It consists of the glans penis, the body, and the root. The glans penis is the soft, rounded portion at the distal end of the penis. The urethra (the tube that carries urine) opens at the tip of the glans. The glans is naturally covered by elongated penile skin—the foreskin—which may be retracted to expose the glans. However, many men as newborns have undergone circumcision, which is a procedure to remove the foreskin. The body of the penis is composed of erectile tissues containing numerous blood vessels that become dilated, leading to an erection during sexual excitement. The urethra, which passes through the penis, extends from the bladder through the prostate to the distal end of the penis.

The prostate gland, lying just below the neck of the bladder, is composed of four zones and four lobes. It surrounds the urethra and is traversed by the ejaculatory duct, a continuation of the vas deferens. This gland produces a secretion that is chemically and physiologically suitable to the needs of the spermatozoa in their passage from the testes. Cowper glands lie below the prostate, within the posterior aspect of the urethra. This gland empties its secretions into the urethra during ejaculation, providing lubrication.

Gerontologic Considerations

As men age, the prostate gland enlarges; prostate secretion decreases; the scrotum hangs lower; the testes decrease in weight, atrophy, and become softer; and pubic hair becomes sparser and stiffer. Changes in gonadal function include a decline in plasma testosterone levels and reduced production of progesterone (see Table 46-1). Libido and potency often decrease in as many as two thirds of men older than 70 years (Tabloski, 2014). Vascular problems cause about half of the cases of impotence in men older than 50 years.

However, male reproductive capability is maintained with advancing age. Although degenerative changes occur in the seminiferous tubules and sperm production decreases,

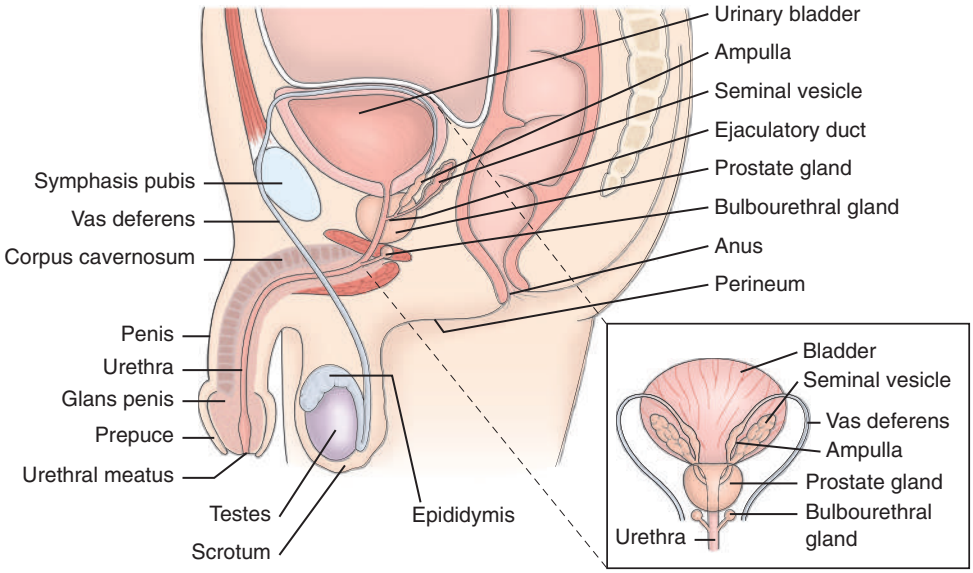


Figure 46-1 • Structures of the male reproductive system.

TABLE 46-1 Age-Related Changes in the Male Reproductive System

Age-Related Changes	Physiologic Changes	Manifestations
Decrease in sex hormone secretion, especially testosterone	Decreased muscle strength and sexual energy	Changes in sexual response—prolonged time to reach full erection, rapid penile detumescence, and prolonged refractory period
		Decrease in number of viable sperm
	Shrinkage and loss of firmness of testes; thickening of seminiferous tubules	Smaller testes
	Fibrotic changes of corpora cavernosa	Erectile dysfunction
	Enlargement of prostate gland	Weakening of prostatic contractions
		Hyperplasia of prostate gland
		Signs and symptoms of obstruction of lower urinary tract (urgency, frequency, nocturia)

Adapted from Tabloski, P. A. (2014). Gerontological nursing: The essential guide to clinical practice (3rd ed.). New York: Pearson.

spermatogenesis continues, allowing men to produce viable sperm throughout their lives (McCance, Huether, Braskers, et al., 2013).

Male hypogonadism (decreased function of the testes) starts gradually at approximately 50 years of age, resulting in decreased testosterone production. The older man notices that the sexual response slows, erection takes longer, full erections may not be attained, and ejaculation takes longer to occur and control or resolution may occur without orgasm. Sexual function can be affected by psychological problems, illnesses, and medications (Mulhall & Hsiao, 2014). In general, the entire sexual act takes longer. Sexual activity is closely correlated with the man's sexual activity in his earlier years; if he was more active than average as a young man, he will most likely continue to be more active than average in his later years.

Men older than 50 years are at increased risk for genitourinary tract cancers, including those of the kidney, bladder, prostate, and penis. The digital rectal examination (DRE), prostate-specific antigen (PSA) test, and urinalysis, which screens for hematuria, may uncover a higher percentage of malignancies at earlier stages and lead to lower treatment-associated morbidity as well as a lower mortality.

Urinary incontinence occurs in one fifth of elderly man residing in families and rises to nearly 50% in men in old-age homes. Older adults admitted to hospitals should be screened for this problem. Urinary incontinence may have many causes, including medications, neurologic disease, or benign prostatic hyperplasia (BPH). Incontinence may also be linked to erectile dysfunction when there is damage to the neural pathways that initiate an erection (Lim, 2013). Diagnostic tests are performed to exclude reversible causes. New-onset urinary incontinence is a nursing priority that requires evaluation.

Assessment

Health History

Male sexuality is a complex phenomenon that is strongly influenced by personal, cultural, religious, and social factors. Sexuality and male reproductive function become concerns in the presence of illness and disability (Norton & Tremayne, 2015). Throughout the assessment process, the nurse must recognize the importance of sexuality to the patient. Assessment of male reproductive function begins with an evaluation of urinary function and symptoms. The patient is asked about his usual state of health and any recent change in general physical and sexual activity. Any symptoms or changes in function are explored fully and described in detail. Symptoms related to bladder function and urination, collectively referred to as prostatism, are explored further. They may occur with an obstruction caused by an enlarged prostate gland: increased urinary frequency, decreased force of urine stream, and "double" or "triple" voiding (the patient needs to urinate two or three times over a period of several minutes to completely empty his bladder). The patient is also assessed for dysuria (painful urination), hematuria (blood in the urine), nocturia (urination during the night), and hematospermia (blood in the ejaculate).

Assessment also involves addressing sexual function, including manifestations of sexual dysfunction. The extent of the history depends on the patient's presenting symptoms and the presence of factors that may affect sexual function such as chronic illnesses or disability (e.g., diabetes, multiple sclerosis, stroke, cardiac disease), the use of medications that affect sexual function (e.g., antihypertensive and anticholesterolemic medications, psychotropic agents), stress, the use of alcohol, and the patient's willingness to discuss sexual issues.

By initiating an assessment about sexual concerns, the nurse conveys the message that changes in sexual functioning are valid topics and provides a safe environment for discussing these sensitive topics. A number of models are available to assist in assessing patient's problems and concerns. The PLISSIT (*p*ermission, *l*imited *i*nformation, *s*pecific *s*uggestions, *i*ntensive *t*herapy) model of sexual assessment and intervention may be used to provide a framework for nursing interventions (Norton & Tremayne, 2015). It provides a graded counseling approach that allows health care professionals to deal with sexual issues with a level of comfort and expertise. The model begins by asking the patient's permission (P) to discuss sexual functioning. Limited information (LI) about sexual function may then be provided to the patient. As the discussion progresses, the nurse may offer specific suggestions (SS) for interventions. A professional who specializes in sex therapy may provide more intensive therapy (IT) as needed. The BETTER (*b*ringing up the topic, *e*xplaining, *t*elling, *t*iming, *e*ducate about treatment-related sexual side effects, *r*ecording) model was developed more recently to assist health care professionals to include sexuality in the assessment of patients with cancer (Tannenbaum, 2015).

Patients may find it difficult to express their feelings and concerns regarding their sexuality, especially after a body image change (e.g., after major surgery such as amputation). Discussing sexuality with patients who have an illness or disability can be uncomfortable for nurses and other health care providers; this, in turn, makes discussion of these issues more difficult and uncomfortable for patients. Health care professionals may unconsciously have stereotypes about the sexuality of people

who are ill or have a disability (e.g., the belief that people with disabilities are asexual or should be sexually inactive). In addition, patients are often embarrassed to initiate a discussion about sexual issues with their health care providers (Gledhill & Schweitzer, 2013); (Mitchell, Mercer, Ploubidis, et al., 2013).

Physical Assessment

In addition to the usual aspects of the physical examination, two essential components address disorders of the male genital or reproductive system: the DRE and the testicular examination.

Digital Rectal Examination

The DRE is used to screen for prostate cancer and is recommended annually for every man older than 50 years (45 years for men at high risk). The DRE enables the skilled examiner, using a lubricated, gloved finger placed in the rectum, to assess the size, symmetry, shape, and consistency of the posterior surface of the prostate gland (see Fig. 46-2). The clinician assesses for tenderness of the prostate gland on palpation and for the presence and consistency of any nodules. The DRE may be performed with the patient leaning over an examination table or positioning the man in a side-lying position with legs flexed toward the abdomen or supine with legs resting in stirrups. To minimize discomfort and relax the anal sphincter during the rectal examination, the patient is instructed to take a deep breath and exhale slowly as the practitioner inserts a finger. If possible, he should turn his feet inward so his toes are touching. Although this examination may be uncomfortable and embarrassing for the patient, it is an important screening tool.

Testicular Examination

The male genitalia are inspected for abnormalities and palpated for masses. The scrotum is palpated carefully for nodules, masses, or inflammation. Examination of the scrotum can reveal such disorders as hydrocele, inguinal hernia, testicular torsion, orchitis, epididymitis, or a tumor of the testis. The penis is inspected and palpated for ulcerations, nodules, inflammation, discharge, and curvature. If the patient is uncircumcised, the foreskin should be retracted for visualization of the glans penis. The testicular examination provides an excellent opportunity to instruct the patient on how to perform a testicular self-examination (TSE) and its importance in early detection of testicular cancer. TSE should begin during adolescence. For more details on TSE, see later discussion in the chapter and Chart 46-6.

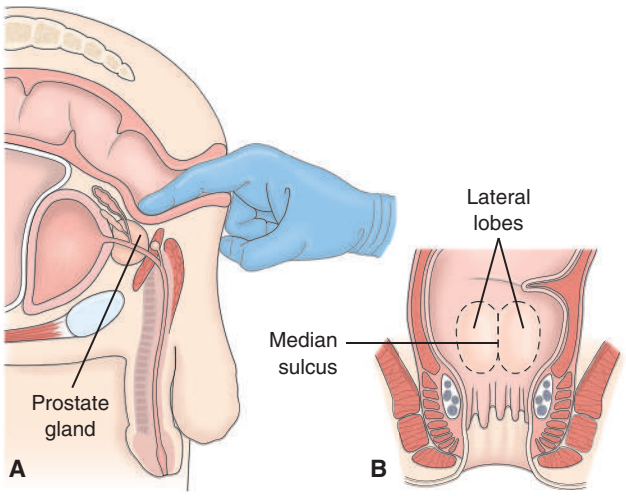


Figure 46-2 • A. Palpation of the prostate gland during digital rectal examination enables the examiner to assess the size, shape, and texture of the gland. **B.** The prostate is round, with a palpable median sulcus or groove separating the lateral lobes. It should feel rubbery and free of nodules and masses.

Diagnostic Evaluation

A wide range of diagnostic studies may be performed in men with reproductive disorders. The nurse should educate the patient about the purpose, what to expect, and any possible side effects related to these tests and examinations prior to testing. The nurse should note trends in results because they provide information about disease progression as well as the patient's response to therapy.

Prostate-Specific Antigen Test

The cells within the prostate gland produce a protein that can be measured in the blood called the prostate-specific antigen (PSA). It is a sensitive but not specific test for prostate cancer. In the absence of prostate cancer, serum PSA levels vary with age, race, and prostate volume. Increased levels may indicate prostate cancer. However, a number of other conditions such as BPH, acute urinary retention, and acute prostatitis may cause high PSA levels. Values of PSA may also increase after ejaculation. PSA levels are measured in nanograms per milliliter (ng/mL). In most laboratories, values less than 4 ng/mL are generally considered normal, and values greater than 4 ng/mL are considered elevated (Barry & Hayes, 2015); (Pagana & Pagana, 2013). The use of age-specific reference ranges is encouraged to help minimize unnecessary biopsies.

A serum PSA level and a DRE, which are recommended by the ACS (2015), are used to screen for prostate cancer for men with at least a 10-year life expectancy and for men at high risk, including those with a strong family history of prostate cancer. The PSA test is also used to monitor patients for recurrence after treatment for cancer of the prostate, based on evidence-based guidelines (National Comprehensive Cancer Network [NCCN], 2016b). Neither the DRE nor PSA is 100% accurate, but when used together, their accuracy increases.

Ultrasonography

Transrectal ultrasound (TRUS) may be performed in patients with abnormalities detected by DRE and in those with elevated PSA levels. After DRE has been completed, a lubricated, condom-covered, rectal probe transducer is inserted into the rectum (Itano, Brant, Conde, et al., 2016). Water may be introduced into the condom to help transmit sound waves to the prostate. TRUS may be used in detecting nonpalpable prostate cancers and in staging localized prostate cancer. Needle biopsies of the prostate are commonly guided by TRUS.

Prostate Fluid or Tissue Analysis

Specimens of prostate fluid or tissue may be obtained for culture if disease or inflammation of the prostate gland is suspected. A biopsy of the prostate gland may be necessary to obtain tissue for histologic examination. This may be performed at the time of prostatectomy or by means of a perineal or transrectal needle biopsy. Six to 12 biopsies from all four prostate zones may be obtained during a TRUS-guided biopsy.

Tests of Male Sexual Function

If the patient cannot engage in sexual intercourse to his satisfaction, a detailed history is obtained. Nocturnal erections occur in healthy males of all ages. Nocturnal penile tumescence tests may be conducted in a sleep laboratory to monitor changes in penile circumference during sleep using various methods to determine number, duration, rigidity, and circumference of penile erections; the results help identify whether the erectile dysfunction is caused by physiologic or psychological factors. Additional tests, including psychological evaluations, are also part of the diagnostic workup and are usually conducted by a specialized team of health care providers.

DISORDERS OF MALE SEXUAL FUNCTION

Erectile Dysfunction

Erectile dysfunction, also called *impotence,* is the inability to achieve or maintain an erect penis (Grossman & Porth, 2014). The man may report decreased frequency of erections, inability to achieve a firm erection, or rapid detumescence (subsiding of erection). In the United States, 30 million men experience erectile dysfunction; more than half of men 40 to 70 years of age are unable to attain or maintain an erection sufficient for satisfactory sexual performance (Keane & Graham, 2016). The physiology of erection and ejaculation is complex and involves parasympathetic and sympathetic components. Erection involves the release of nitric oxide into the corpus cavernosum during sexual stimulation. Its release activates cyclic guanosine monophosphate (cGMP), causing smooth muscle relaxation. This allows flow of blood into the corpus cavernosum, resulting in erection (Grossman & Porth, 2014); (McDougal, Wein, Kavoussi, et al., 2016).

There are no sufficient statistical data to reveal the exact number of patients suffering from erectile dysfunction in India, though a study reports about 47.8% of men with erectile dysfunction. Prevalence rate of erectile dysfunction is higher (69.9%) among diabetic patients than in nondiabetic persons (Seid, Gerensea, Tarko, et al., 2017). The most common causes of this condition are diabetes mellitus, financial stress, and use of psychiatric treatment for disorders such as depression and anxiety (Thangadurai, Gopalakrishnan, Abraham, et al., 2014).

Erectile dysfunction has both psychogenic and organic causes. Psychogenic causes include anxiety, fatigue, depression, pressure to perform sexually, negative body image, absence of desire, and privacy, as well as trust and relationship issues. Organic causes include cardiovascular disease, endocrine disease (diabetes, pituitary tumors, testosterone deficiency, hyperthyroidism, and hypothyroidism), cirrhosis, chronic kidney injury, genitourinary conditions (radical pelvic surgery), hematologic conditions (Hodgkin lymphoma, leukemia), neurologic disorders (neuropathies, parkinsonism, spinal cord injury [SCI], multiple sclerosis), trauma to the pelvic or genital area, alcohol, smoking, medications (see Chart 46-1), and drug abuse.

Chart 46-1 PHARMACOLOGY

Medications Associated with Erectile Dysfunction

- *Antiadrenergics and antihypertensives:* Guanethidine (Ismelin), clonidine (Catapres), hydralazine (Apresoline)
- *Anticholinergics and phenothiazines:* Prochlorperazine (Compazine), trihexyphenidyl (Artane)
- *Antidepressants:* tricyclic antidepressants: Amitriptyline (Elavil), desipramine (Norpramin); selective serotonin reuptake inhibitors: Fluoxetine (Prozac), sertraline (Zoloft)
- *Antifungals:* Ketoconazole (Nizoral)
- *Antihistamines:* Diphenhydramine (Benadryl), dimenhydrinate (Dramamine)
- *Antihormone (prostate cancer treatment):* Flutamide (Eulexin), leuprolide (Lupron)
- *Antipsychotics:* haloperidol (Haldol), Chlorpromazine (Thorazine)
- *Anticonvulsant agents:* Carbamazepine (Tegretol)
- *Antispasmodics:* Oxybutynin (Ditropan)
- *Anxiolytics, sedative–hypnotics, tranquilizers:* Lorazepam (Ativan), triazolam (Halcion)
- *Beta-blockers:* Nadolol (Corgard), metoprolol (Lopressor)
- *Calcium channel blockers:* Nifedipine (Adalat, Procardia)
- *Carbonic anhydrase inhibitors:* Acetazolamide (Diamox)
- *Chemotherapeutic agents:* Busulfan (Myleran), cyclophosphamide (Cytoxan)
- *Diuretics:* hydrochlorothiazide (HydroDIURIL), Furosemide (Lasix), spironolactone (Aldactone), verapamil (Calan)
- *Histamine-2 antagonists:* Nizatidine (Axid), ranitidine (Zantac)
- *Nonsteroidal anti-inflammatory drugs:* Naproxen (Naprosyn), indomethacin (Indocin)
- *Other substances:* alcohol, amphetamines, barbiturates, cocaine, marijuana, methadone, nicotine, opioids
- *Parkinson disease medications:* carbidopa/levodopa (Sinemet), benztropine (Cogentin)

Adapted from Karch, A. M. (2016). 2016 Lippincott pocket drug guide for nurses. (4th ed.). Philadelphia, PA: Wolters Kluwer.

Assessment and Diagnostic Findings

The diagnosis of erectile dysfunction requires a sexual and medical history; an analysis of presenting symptoms; a physical examination, including a neurologic examination; a detailed assessment of all medications, alcohol, and drugs used; and various laboratory studies. Nocturnal penile tumescence tests are conducted to monitor changes in penile circumference. This test can help to determine if erectile impotence has an organic or a psychological cause. In healthy men, nocturnal penile erections closely parallel rapid eye movement (REM) sleep in occurrence and duration. Organically impotent men show inadequate sleep-related erections that correspond to their waking performance. Arterial blood flow to the penis is measured using a Doppler probe. In addition, nerve conduction tests and extensive psychological evaluations may be carried out. Figure 46-3 describes the evaluation and treatment of erectile dysfunction.

Medical Management

Treatment can be medical, surgical, or both, depending on the cause. Treatment of erectile dysfunction includes therapy for associated disorders (e.g., alcoholism, diabetes) or adjustment of medications (Mola, 2015). Endocrine therapy instituted to treat erectile dysfunction secondary to hypothalamic–pituitary–gonadal dysfunction may reverse the condition. Insufficient penile blood flow may be treated with vascular surgery. Patients with erectile dysfunction from psychogenic causes are referred to a health care provider or therapist who specializes in sexual dysfunction. Patients with erectile dysfunction secondary to organic causes may be candidates for penile implants.

Currently available therapies for the treatment of erectile dysfunction include pharmacologic therapy (including urethral

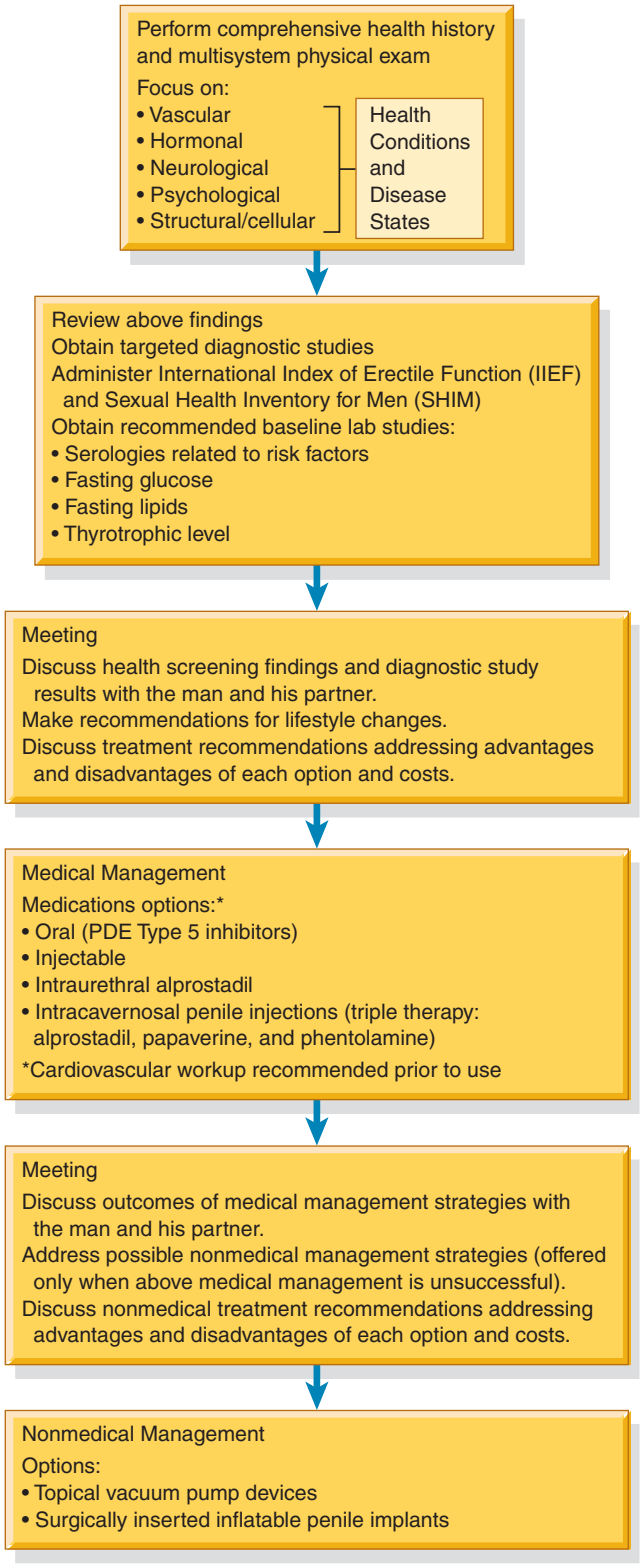


Figure 46-3 • Evaluation and treatment of erectile dysfunction.

suppositories), penile implants, and vacuum constriction devices (see Table 46-2). These options should be considered in a stepwise fashion, with increasing invasiveness and risk balanced against the likelihood of efficacy. The patient and, if possible, his partner, should be informed of the relevant treatment options and their associated risks and benefits. The choice of treatment is made jointly by the primary provider, patient, and partner, taking into consideration patient preferences and expectations.

Pharmacologic Therapy

Phosphodiesterase type 5 (PDE-5) inhibitors (oral medications that are used to treat erectile dysfunction) are first-line therapy (Hsu, Tang, & Lu, 2014). Currently available PDE-5 inhibitors include sildenafil (Viagra), vardenafil (Levitra), and tadalafil (Cialis). Each of these agents has a similar mechanism of action but a different pharmacologic action and clinical use. Erection involves the release of nitric oxide in the vasculature of the corpus cavernosum as a result of sexual stimulation. This subsequently leads to smooth muscle relaxation in blood vessels supplying the corpus cavernosum, resulting in increased blood flow and an erection. During sexual stimulation, PDE-5 inhibitors increase blood flow to the penis (Grossman & Porth, 2014).

When PDE-5 inhibitors are taken about 1 hour before sexual activity, they are effective in producing an erection with sexual stimulation; the erection can last about 1 to 2 hours. The most common side effects of these medications include headache, flushing, dyspepsia, diarrhea, nasal congestion, and lightheadedness. These agents are contraindicated in men who take organic nitrates (e.g., isosorbide [Isordil], nitroglycerin), because taken together, these medications can cause side effects such as severe hypotension (Grossman & Porth, 2014); (McDougal et al., 2016). In addition, PDE-5 inhibitors must be used with caution in patients with retinopathy, especially in those with diabetic retinopathy. Patient education about the use of these medications and their side effects is summarized in Table 46-3.

For patients in whom PDE-5 inhibitors are contraindicated or ineffective, other pharmacologic measures to induce erections include injecting vasoactive agents, such as alprostadil, papaverine, and phentolamine, directly into the penis. Complications include priapism (a persistent abnormal erection) and development of fibrotic plaques at the injection sites. Alprostadil is also formulated in a gel pellet that can be inserted into the tip of the urethra with an applicator to create an erection.

Penile Implants

Two general types of penile implants are available: the malleable, noninflatable, nonhydraulic prosthesis (also called the *semirigid rod*) and the inflatable, hydraulic prostheses (Keane & Graham, 2016). The semirigid rod (e.g., the Small-Carrion prosthesis) results in a permanent semierection but can be bent into an unnoticeable position when appropriate. The inflatable prosthesis simulates natural erections and natural flaccidity. Complications after implantation include infection, erosion of the prosthesis through the skin (more common with the semirigid rod than with the inflatable prosthesis), and persistent pain, which may require removal of the implant. Subsequent cystoscopic surgery is more difficult with a semirigid rod than with the inflatable prosthesis.

Factors to consider in choosing a penile prosthesis are the patient's activities of daily living, social activities, and the expectations of the patient and his partner. Ongoing counseling for the patient and his partner is usually necessary to help them adapt to the prosthesis.

Penis Transplants

The first successful penis transplant was performed in 2014 in Cape Town, South Africa. Candidates for transplantation include military veterans and other men who have suffered

TABLE 46-2 Treatments for Erectile Dysfunction

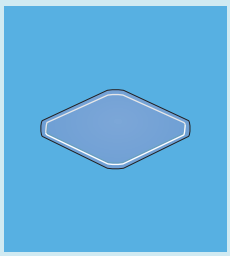
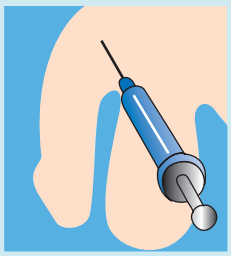
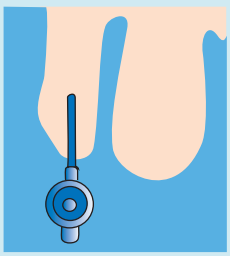
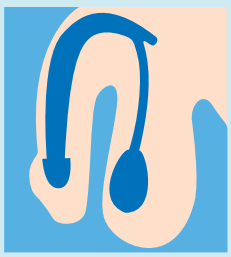
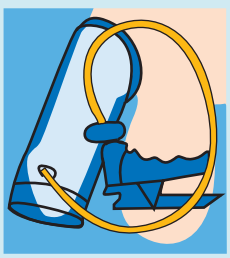
Method	Description	Advantages and Disadvantages	Duration
Pharmacologic Therapy Oral medications (sildenafil [Viagra]; vardenafil [Levitra]; tadalafil [Cialis])  Oral medication	Smooth muscle relaxant causing blood to flow into penis	Can cause headache flushing, dyspepsia, diarrhea, nasal congestion, and lightheadedness See contraindications in Table 46-3	Taken orally before intercourse. Stimulation is required to achieve erection. Erection can last 1 hour.
Injection (alprostadil, papaverine, phentolamine)  Penile injection	Smooth muscle relaxant causing blood to flow into penis	Firm erections are achievable in >50% of cases. Pain at injection site; plaque formation, risk of priapism	Injection 20 minutes before intercourse Erection can last up to 1 hour.
Urethral suppository (alprostadil)  Penile suppository	Smooth muscle relaxant causing blood to flow into penis	May be used twice a day Urethral and genital pain; risk of hypertension and syncope Not recommended with pregnant partners	Inserted 10 minutes before intercourse Erection can last up to 1 hour.
Penile Implants • Semirigid rod • Inflatable • Soft silicone  Penile implant	Surgically implanted into corpus cavernosum	Reliable Requires surgery Healing takes up to 3 weeks. Subsequent cystoscopic surgery is difficult. Semirigid rod results in permanent semierection.	Indefinite Inflatable prosthesis—saline returns from penile receptacle to reservoir.
Negative-Pressure (Vacuum) Devices  Penile vacuum pump	Induction of erection with vacuum; maintained with constriction band around base of penis	Few side effects Cumbersome to use before intercourse Vasocongestion of penis can cause pain or numbness.	To prevent penile injury, constriction band must not be left in place >1 hour.

TABLE 46-3 Pharmacologic Treatment of Erectile Dysfunction

	Sildenafil (Viagra)	Vardenafil (Levitra)	Tadalafil (Cialis)
When to take	Take the medication 30 minutes to 4 hours before intercourse. *There must be sexual stimulation to produce an erection.*	Follow the same directions as with sildenafil; take the medication 1 hour before intercourse. The peak action occurs in 30–120 minutes. *There must be sexual stimulation to produce an erection.*	Take the medication before sexual activity. Effect peaks at 30 minutes to 6 hours; effect may last up to 36 hours. *There must be sexual stimulation to produce an erection.*
Frequency of use	If you take this medication more than once a day, it will not have an increased effect. You may take it 7 days per week if you wish, but only once in 24 hours. It does not build up in your bloodstream. Remember to take it only when you want to have intercourse.	The recommended frequency for this medication is 10 mg in 24 hours.	The effects of this medication may last up to 36 hours. This allows for increased spontaneity in the sexual experience.
Side effects	Side effects include headache, flushing, indigestion, nasal congestion, abnormal vision, diarrhea, dizziness, and rash. You may also have low blood sugar and abnormal liver function tests; your primary provider can determine this.	Side effects include headache, flushing, runny nose, indigestion, sinusitis, flulike syndrome, dizziness, nausea, back pain, and joint pain. Tell your primary provider if you experience any of these effects. You may also have abnormally elevated liver enzymes; your primary provider can determine this.	Side effects are similar to those of sildenafil and vardenafil. Tadalafil may also cause back pain and muscle aches. Tell your primary provider if you experience any of these side effects.
Contraindications	Do not take if you are taking nitrate medications such as nitroglycerin (e.g., Nitro-Bid) or isosorbide mononitrate (e.g., Imdur). Do not take if you have high uncontrolled blood pressure, coronary artery disease, or have had a heart attack within the past 6 months. Do not take if you have been diagnosed with a cardiac dysrhythmia or kidney or liver dysfunction.		
Drug interactions	This medication can react with other medications that you may be taking. Provide your primary provider and pharmacist with a complete list of all prescribed and over-the-counter medications that you are using.		
Use of PDE-5 inhibitors with penile injections or urethral suppositories	The use of PDE-5 inhibitors with other forms of therapy for erectile dysfunction has not been tested and should be avoided.		

PDE-5, phosphodiesterase type 5.

Adapted from Hsu, J. C., Tang, D. H., & Lu, C. Y. (2014). Risk-benefit assessment of oral phosphodiesterase type 5 inhibitors for treatment of erectile dysfunction: A multiple criteria decision analysis. International Journal of Clinical Practice, 69(4), 436–443.

traumatic penile injuries. It is believed that men undergoing this surgery will have their ability to urinate and their sexual functioning restored (Kuehn, 2016); (Kumnig & Jowsey-Gregoire, 2016). For more details on organ transplantation, see discussion in Chapter 44.

Negative-Pressure Devices

Negative-pressure (vacuum) devices may also be used to induce an erection. A plastic cylinder is placed over the flaccid penis, and negative pressure is applied. When an erection is attained, a constriction band is placed around the base of the penis to maintain the erection. To avoid penile injury, the patient is instructed not to leave the constricting band in place for longer than 1 hour. Only devices with a vacuum limiter are recommended for use (Mulhall & Hsiao, 2014). Although many men find this method satisfactory, others experience premature loss of penile rigidity or pain when applying suction or during intercourse.

Nursing Management

Personal satisfaction and the ability to sexually satisfy a partner are common concerns of patients. Men with illnesses and disabilities may need the assistance of a sex therapist to identify, implement, and integrate their sexual beliefs and behaviors into a healthy and satisfying lifestyle. The nurse can inform patients about support groups for men with erectile dysfunction and their partners.

Disorders of Ejaculation

Premature ejaculation (PE) is defined as the occurrence of ejaculation sooner than desired, either before or shortly after penetration, causing distress to either one or both partners. It is one of the most common complaints of men or couples, affecting 20% to 30% of men (Keane & Graham, 2016); (McDougal et al., 2016). The spectrum of responses ranges from occasional ejaculation with intercourse or self-stimulation to complete inability to ejaculate under any circumstances. Various forms of PE have been identified: (1) lifelong PE caused by neurobiologic or genetic conditions, (2) acquired PE (medical or psychological), (3) natural variable PE (normal variation), and (4) prematurelike ejaculatory dysfunction (psychological). In young men ages 18 to 25 years, factors associated with PE and erectile dysfunction include smoking, use of illegal drugs or medications without prescriptions, poor physical and mental health, lack of physical activity and lack of sexual experience (Akre, Berchtold, Gmel, et al., 2014). Other ejaculatory problems may include inhibited (delayed or

Chart 46-2 GENETICS IN NURSING PRACTICE

Male Reproductive Disorders

Various male reproductive disorders are influenced by genetic factors. Some examples are:

- 21-Hydroxylase deficiency
- Congenital absence of the vas deferens, prostate gland or seminal vesicles
- Kallmann syndrome
- Klinefelter syndrome (47, XXY)
- Prostate cancer
- Y chromosome deletions

Nursing Assessments

Refer to Chapter 3 Chart 3-2: Genetics in Nursing Practice: Genetic Aspects of Health Assessment

Family History Assessment Specific to Male Reproductive Disorders

- Collect a three-generation family history on both maternal and paternal sides of the family.
- Assess family history for other family members with similar reproductive problems/abnormalities.

Patient Assessment Specific to Male Reproductive Disorders

- In males with delayed puberty or infertility, assess for clinical features of Klinefelter syndrome (tall stature, gynecomastia, learning disabilities).
- Assess males with delayed or absent puberty for clinical features of Kallmann syndrome (cleft lip with or without cleft palate, abnormal eye movements, hearing loss, and abnormalities of tooth development).
- Assess males for history of early growth spurt, which is a symptom of 21-hydroxylase deficiency.
- Inquire about history of prostate inflammation, genital infections, medication use (steroids), or prior history of mumps.
- Assess for physical abnormalities of the genitalia

Genetics Resources

Association for X and Y Chromosome Variations, www.genetic.org
Klinefelter Syndrome Support Group, www.klinefeltersyndrome.org

retarded) ejaculation, which is the involuntary inhibition of the ejaculatory reflex (see Chart 46-2). Retrograde ejaculation occurs when semen travels toward the bladder instead of exiting through the penis, resulting in infertility. This form of PE may occur after prior prostate or urethral surgery, with diabetes, or with the use of medications such as antihypertensive agents.

Evaluation of PE involves a thorough sexual history focusing on the duration of symptoms, time to ejaculation, degree of voluntary control over ejaculation, frequency of occurrence, and course of the problem since the first sexual encounter (Keane & Graham, 2016); (McDougal et al., 2016). Treatment, which depends on the nature and severity of PE and perceived distress that it causes, includes behavioral and psychological approaches, as well as pharmacologic therapy that attempts to alter the sensory input or retard the ejaculatory response. Behavioral therapy (e.g., counseling, sex therapy, psychoeducation, and couples therapy) often involves both the man and his sexual partner. The couple is encouraged to identify their sexual needs and to communicate those needs to each other. Pharmacologic management involves selective serotonin reuptake inhibitors dapoxetine (Priligy), alpha$_1$ adrenoceptor antagonists, the tricyclic antidepressant clomipramine (Anafranil), and topical anesthetic agents. In some cases, a combination of pharmacologic and behavioral therapy may be effective.

Inhibited ejaculation is most often caused by psychological factors, neurologic disorders (e.g., SCI, multiple sclerosis, neuropathy secondary to diabetes), surgery (prostatectomy), and medications. Chemical, vibratory, and electrical methods of stimulation have been used with some success. Treatment usually addresses the physical and psychological factors involved in inhibited ejaculation (Wincze & Weisberg, 2015). Although outpatient therapy may involve numerous sessions (12 to 18), it often results in a success rate of 70% to 80%. The outcome depends on a previous satisfying sexual experience history, a short duration of the ejaculatory problem, feelings of sexual desire, feelings of attraction to one's sexual partner, motivation for treatment, and absence of serious psychological problems.

For men with retrograde ejaculation, the urine may be collected shortly after ejaculation, revealing a large amount of sperm in the urine. This urine may also be collected to obtain adequate viable sperm for use in artificial insemination. In men with SCI, techniques that may be used to obtain sperm for artificial insemination include self-stimulation, vibratory stimulation, or electroejaculation. Electroejaculation involves the use of a specially designed probe that is inserted into the rectum next to the prostate. The probe delivers a current that stimulates the nerves and produces contraction of the pelvic muscles and ejaculation. However, spontaneous or stimulated ejaculation may cause autonomic dysreflexia (overstimulation of the autonomic nervous system) in patients with SCI at T6 or higher, creating a life-threatening situation (see Chapter 51). If this disorder is not treated promptly, it may lead to seizures, stroke, and even death.

Infertility

Infertility is defined as a couple's inability to achieve pregnancy after 1 year of unprotected intercourse (Tarin, Garcia-Perez, Hamatani, et al., 2015). Approximately 12% of women aged 15 to 44 have reported ever having received any infertility services (Kessler et al., 2013). Primary infertility refers to a couple who has never had a child. Secondary infertility means that at least one conception has occurred, but currently the couple cannot achieve a pregnancy. It is often a complex physical problem and causes are related to endometriosis, uterine factors, anovulation, tubal obstruction, and male factors.

The overall prevalence rate of infertility in India ranges from 3.9% to 16.8%. In India, the infertility rate differs from state to state. The lowest rate is in Uttar Pradesh (3.7%) and the highest in Kashmir (15%); also, it varies based on region, tribe, and caste (Kumar & Singh, 2015).

Causes

Female Factors

- Ovarian and ovulation factors: Production of unhealthy ovum or no ovum at all
- Tubal and uterine factors: Endometriosis or tubal block; fibroids, polyps, and congenital malformations being the possible causative factors affecting the uterus

Male Factors

- Qualitative or quantitative deficiency in sperms: An analysis of semen provides information about the number of sperms (density), percentage of moving forms, quality of forward

movement (forward progression), and morphology (shape and form). 2–6 mL of semen with alkaline pH is considered normal. A normal count has 60 to 100 million sperms/mL. However, the incidence of impregnation is lessened only when the count decreases to fewer than 20 million sperms/mL.
- Erectile dysfunction: It may lead to infertility.
- Varicoceles (varicose veins around the testicle): These decrease the semen quality by increasing the testicular temperature.
- Retrograde ejaculation or ejaculation into the bladder: It may also lead to infertility.
- Hormonal imbalances: Blood tests for male hormones, namely, testosterone, FSH, and LH, may be reduced. These hormones are essential for optimal male sexuality.

Nursing Management

Management of male infertility is planned based on the causative factor. Nurses need to address the emotional needs of the patients as they may feel anxious and stressed. Counseling and reassurance are essential. For diagnosis and management, refer the previous sections.

INFECTIONS OF THE MALE GENITOURINARY TRACT

Acute uncomplicated cystitis in adult men is uncommon but occasionally occurs. Asymptomatic bacteriuria may also result from genitourinary manipulation, catheterization, or instrumentation. Urinary tract infections (UTIs) are discussed in Chapter 45.

According to the Centers for Disease Control and Prevention (CDC, 2015), more than 19 million people develop sexually transmitted infections (STIs) annually in the United States; almost half of all STIs occur in people 18 to 24 years of age. The incidence of STIs has declined over the past several years, except in specific populations, including men who have sex with men. Routine human papillomavirus (HPV) vaccination for all males has become the standard of preventative care since 2011, as recommended by the Advisory Committee on Immunization Practices (ACIP) (Gerend, Madkins, Phillips, et al., 2016).

As per World Health Organization (WHO) report, 498.9 million curable sexually transmitted infections (STIs) occur worldwide (WHO, 2008). In India, the population prevalence rate of STIs (e.g., syphilis, gonorrhea, and chlamydia) is 0–3.9%. The prevalence rate of HIV among adults (15–49 years) has declined in India from 0.38% (2001–2003) to 0.34% (2007). There are declining HIV prevalence trends in the traditional high-prevalent southern states such as Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, and Telangana. However, the results have alerted the program in Gujarat, Punjab, Rajasthan, Haryana, Uttar Pradesh, Delhi, and Bihar where the epidemic is showing a rising trend. There is a target to eliminate HIV as a public health problem in India by 2030 (NACO, 2017).

STIs affect people from all walks of life—from all social, educational, economic, and racial backgrounds. The single greatest risk factor for contracting an STI is the number of sexual partners. As the number of partners increases, so does the risk of exposure to a person infected with an STI. For men who have sex with men, the CDC recommends annual testing for human immune deficiency virus (HIV), syphilis, *Chlamydia,* gonorrhea, hepatitis B viral infection, and herpes simplex virus type 2, along with counseling (CDC, 2015); (Owusu-Edusei, Gift, Patton, et al., 2015).

There are many causes of urethritis (gonococcal and nongonococcal), genital ulcers (genital herpes infections, primary syphilis, chancroid, granuloma inguinale, and lymphogranuloma venereum), genital warts (HPV), scabies, pediculosis pubis, molluscum contagiosum, hepatitis and enteric infections, proctitis, and acquired immune deficiency syndrome (AIDS). Trichomoniasis and STIs characterized by genital ulcers are thought to increase susceptibility to HIV infection. Trichomoniasis is associated with nonchlamydial, nongonococcal urethritis.

Current treatment guidelines for STIs are available from the CDC (2015); (Lanier & Sutton, 2013). Treatment must target the patient as well as his sexual partners and sometimes an unborn child. A thorough history, including a sexual history, is crucial to identify patients at risk and to direct care and education. It is essential for patient education to focus on partner safety as people can misjudge partner safety with known acquaintances, thus causing individuals to be at greater risk of STI/HIV transmission (Sparling & Cramer, 2015).

Partners of men with STIs must also be examined, treated, and counseled to prevent reinfection and complications in both partners and to limit the spread of the disease. Sexual abstinence during treatment and recovery is advised to prevent the transmission of STIs. The use of synthetic condoms for at least 6 months after completion of treatment is recommended to decrease transmission of HPV infection as well as other STIs. It is important to assess and test for other STIs because patients who have one STI may also have another. The use of spermicides with nonoxynol-9 (known as N-9) is discouraged; these agents do not protect against HIV infection and may increase the risk of transmission of the virus. See Chapter 55 for more detailed discussions of HIV infection, AIDS, and other STIs.

PROSTATIC DISORDERS

Prostatitis

Prostatitis is an inflammation of the prostate gland that is often associated with lower urinary tract symptoms and symptoms of sexual discomfort and dysfunction. The condition affects 5% to 10% of men. It is the most common urologic diagnosis in men younger than 50 years and the third most common such diagnosis in men older than 50 years (McDougal et al., 2016). Prostatitis may be caused by infectious agents (bacteria, fungi, mycoplasma) or other conditions (e.g., urethral stricture, BPH). *Escherichia coli* is the most commonly isolated organism, although *Klebsiella* and *Proteus* species are also found (Chen, Hu, Peng, et al., 2015). The microorganisms colonize the urinary tract and ascend to the prostate, ultimately causing infection. The causal pathogen is usually the same in recurrent infections.

It is reported that in North America, Europe, and Asia, about 2–10% of adult men suffer with symptoms of chronic prostatitis and approximately 15% of men suffer with symptoms of prostatitis at some point of time in their life (Krieger, Riley, Cheah, et al., 2003).

There are four types of prostatitis: acute bacterial prostatitis (type I), chronic bacterial prostatitis (type II), chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS) (type III), and asymptomatic inflammatory prostatitis (type IV). Type III, which occurs in more than 90% of cases, is further classified as

type IIIA or type IIIB, depending on the presence (type IIIA) or absence (type IIIB) of white blood cells in semen after prostate massage (Chen et al., 2015).

Clinical Manifestations

Acute prostatitis is characterized by the sudden onset of fever, dysuria, perineal prostatic pain, and severe lower urinary tract symptoms: dysuria, frequency, urgency, hesitancy, and nocturia. Approximately 5% of cases of type I prostatitis (acute bacterial prostatitis) progress to type II prostatitis (chronic bacterial prostatitis) (McDougal et al., 2016). Patients with type II disease are typically asymptomatic between episodes. Patients with type III prostatitis often have no bacteria in the urine in the presence of genitourinary pain. Patients with type IV prostatitis are usually diagnosed incidentally during a workup for infertility, an elevated PSA test, or other disorders.

Medical Management

The goal of treatment is to eradicate the causal organisms. Hospital admission may be necessary for patients with unstable vital signs, sepsis, or intractable pelvic pain; those who are frail or immunosuppressed; or those who have diabetes or renal insufficiency. Specific treatment is based on the type of prostatitis and on the results of culture and sensitivity testing of the urine (Wagenlehner, Weidner, Pilatz, et al., 2014). If bacteria are cultured from the urine, antibiotic agents, including trimethoprim-sulfamethoxazole (Bactrim) or a fluoroquinolone (e.g., ciprofloxacin [Cipro]), may be prescribed, and continuous therapy with low-dose antibiotic agents may be used. If the patient is afebrile and has a normal urinalysis, anti-inflammatory agents may be used. Alpha-adrenergic blocker therapy (e.g., tamsulosin [Flomax]), may be prescribed to promote bladder and prostate relaxation.

Factors contributing to prostatitis, including stress, neuromuscular factors, and myofascial pain, are also addressed. Supportive, nonpharmacologic therapies may be prescribed. These include biofeedback, pelvic floor training, physical therapy, reduction of prostatic fluid retention by ejaculation through sexual intercourse or masturbation, sitz baths, stool softeners, and evaluation of sexual partners to reduce the possibility of cross-infection.

Nursing Management

If the patient experiences symptoms of acute prostatitis (fever, severe pain and discomfort, inability to urinate, malaise), he may be hospitalized for intravenous (IV) antibiotic therapy. Nursing management includes administration of prescribed antibiotic agents and provision of comfort measures, including prescribed analgesic agents and sitz baths.

The patient with chronic prostatitis is usually treated on an outpatient basis and needs to be educated about the importance of continuing antibiotic therapy and recognizing recurrent signs and symptoms of prostatitis.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

The nurse educates the patient about the importance of completing the prescribed course of antibiotic therapy. If IV antibiotic agents are to be given at home, the nurse educates the patient and family about correct and safe administration. Arrangements for a home care nurse to oversee administration may be needed. Warm sitz baths (10 to 20 minutes) may be taken several times daily. Fluids are encouraged to satisfy thirst but are not "forced," because an effective medication level must be maintained in the urine. Foods and liquids with diuretic action or that increase prostatic secretions, such as alcohol, coffee, tea, chocolate, cola, and spices, should be avoided. A suprapubic catheter may be necessary for severe urinary retention. During periods of acute inflammation, sexual arousal and intercourse should be avoided. To minimize discomfort, the patient should avoid sitting for long periods. Medical follow-up is necessary for at least 6 months to 1 year, because prostatitis caused by the same or different organisms can recur. The patient is advised that the UTI may recur and is educated to recognize its symptoms.

Benign Prostatic Hyperplasia (Enlarged Prostate)

Benign prostatic hyperplasia (BPH), a noncancerous enlargement or hypertrophy of the prostate, is one of the most common diseases in aging men. It can cause bothersome lower urinary tract symptoms that affect quality of life by interfering with normal daily activities and sleep patterns (McDougal et al., 2016). BPH typically occurs in men older than 40 years. By the time they reach 60 years, 50% of men have BPH. It affects as many as 90% of men by 85 years of age. BPH is the second most common cause of surgical intervention in men older than 60 years.

Most of the men in Asia are vegetarian; their low-fat, high-fiber diet is weak in dietary phytoestrogens, which act as chemopreventive agents. In India, very limited studies have been conducted on BPH. The global study done across regions of the world on the incidence of BPH found that the global incidence of BPH was 280.40 per100,000 population and in the South East Asia, it was 348.05 per100,000 population (Xu, Liu, Guo, et al., 2021).

Pathophysiology

The cause of BPH is not well understood, but testicular androgens have been implicated. Dihydrotestosterone (DHT), a metabolite of testosterone, is a critical mediator of prostatic growth. Estrogens may also play a role in the cause of BPH; BPH generally occurs when men have elevated estrogen levels and when prostate tissue becomes more sensitive to estrogens and less responsive to DHT. Smoking, heavy alcohol consumption, obesity, reduced activity level, hypertension, heart disease, diabetes, and a Western diet (high in animal fat and protein and refined carbohydrates, low in fiber) are risk factors for BPH (McDougal et al., 2016); (Tantamango-Bartley, Knutsen, Knutsen, et al., 2016).

BPH develops over a prolonged period; changes in the urinary tract are slow and insidious. BPH is a result of complex interactions involving resistance in the prostatic urethra to mechanical and spastic effects, bladder pressure during voiding, detrusor muscle strength, neurologic functioning, and general physical health (McCance et al., 2013). The hypertrophied lobes of the prostate may obstruct the bladder neck or urethra, causing incomplete emptying of the bladder and urinary retention. As a result, a gradual dilation of the ureters (hydroureter) and kidneys (hydronephrosis) can occur. Urinary retention may result in UTIs because urine that remains in the urinary tract

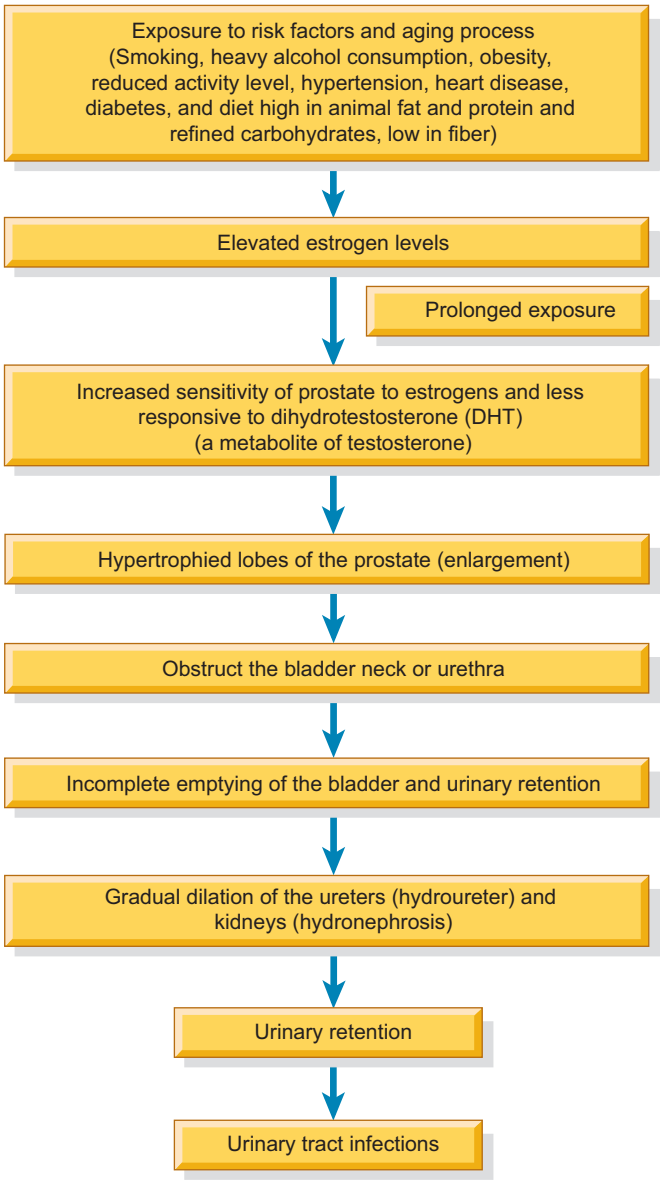


Figure 46-4 • Pathophysiology of benign prostatic hyperplasia.

serves as a medium for infective organisms. Pathophysiology of benign prostatic hyperplasia is presented in Figure 46-4.

Clinical Manifestations

BPH may or may not lead to lower urinary tract symptoms; if symptoms occur, they may range from mild to severe. Severity of symptoms increases with age, and half of men with BPH report having moderate to severe symptoms. Obstructive and irritative symptoms may include urinary frequency, urgency, nocturia, hesitancy in starting urination, decreased and intermittent force of stream and the sensation of incomplete bladder emptying, abdominal straining with urination, a decrease in the volume and force of the urinary stream, dribbling (urine dribbles out after urination), and complications of acute urinary retention and recurrent UTIs. Normally, residual urine amounts to no more than 50 mL in the middle-aged adult and less than 50 to 100 mL in the older adult (Weber & Kelley, 2014). Ultimately, chronic urinary retention and large residual volumes can lead to azotemia (accumulation of nitrogenous waste products) and kidney failure.

Generalized symptoms may also be noted, including fatigue, anorexia, nausea, vomiting, and pelvic discomfort. Other disorders that produce similar symptoms include urethral stricture, prostate cancer, neurogenic bladder, and urinary bladder stones.

Assessment and Diagnostic Findings

The health history focuses on the urinary tract, previous surgical procedures, general health issues, family history of prostate disease, and fitness for possible surgery (Pearson, 2014). A patient voiding diary is used to record voiding frequency and urine volume. A DRE often reveals a large, rubbery, and nontender prostate gland. A urinalysis to screen for hematuria and UTI is recommended. A PSA level is obtained if the patient is without a terminal disease and for whom knowledge of the presence of prostate cancer would change management. The American Urological Association (AUA) Symptom Index or International Prostate Symptom Score (IPSS) can be used to assess the severity of symptoms (Keane & Graham, 2016).

Other diagnostic tests may include recording urinary flow rate and the measurement of postvoid residual urine. If invasive therapy is considered, urodynamic studies, urethrocystoscopy, and ultrasound may be performed. Complete blood studies are performed. Cardiac status and respiratory function are assessed because a high percentage of patients with BPH have cardiac or respiratory disorders due to their age.

Medical Management

The goals of medical management of BPH are to improve quality of life, improve urine flow, relieve obstruction, prevent disease progression, and minimize complications. Treatment depends on the severity of symptoms, the cause of disease, the severity of the obstruction, and the patient's condition.

If a patient is admitted on an emergency basis because he is unable to void, he is immediately catheterized. The ordinary catheter may be too soft and pliable to advance through the urethra into the bladder. In such cases, a thin wire (stylet) is introduced (by a urologist) into the catheter to prevent the catheter from collapsing when it encounters resistance. A metal catheter with a pronounced prostatic curve may be used if obstruction is severe. A cystostomy (incision into the bladder) may be needed to provide urinary drainage.

Discussion of all treatment options by the primary provider enables the patient to make an informed decision based on symptom severity, the effect of BPH on his quality of life, and preference. Patients with mild symptoms and patients with moderate or severe symptoms who are not bothered by them and have not developed complications may be managed with "watchful waiting." With this approach, the patient is monitored and reexamined annually but receives no active intervention (Pearson, 2014). Other therapeutic choices include pharmacologic treatment, minimally invasive procedures, and surgery.

Pharmacologic Therapy

Pharmacologic treatment for BPH includes the use of alpha-adrenergic blockers and 5-alpha-reductase inhibitors (McDougal et al., 2016). Alpha-adrenergic blockers, which include alfuzosin (Uroxatral), terazosin (Hytrin), doxazosin (Cardura), and tamsulosin, relax the smooth muscle of the bladder neck and prostate. This improves urine flow and relieves symptoms of BPH. Side effects include dizziness, headache,

asthenia/fatigue, postural hypotension, rhinitis, and sexual dysfunction (Keane & Graham, 2016); (McDougal et al., 2016).

Another method of treatment involves hormonal manipulation with antiandrogen agents. The 5-alpha-reductase inhibitors finasteride (Proscar) and dutasteride (Avodart) are used to prevent the conversion of testosterone to DHT and decrease prostate size. Side effects include decreased libido, ejaculatory dysfunction, erectile dysfunction, gynecomastia (breast enlargement), and flushing. Combination therapy (doxazosin and finasteride) has decreased symptoms and reduced clinical progression of BPH (Keane & Graham, 2016); (McDougal et al., 2016).

The use of alternative and complementary phytotherapeutic agents and other dietary supplements (*Serenoa repens* [saw palmetto berry] and *Pygeum africanum* [African plum]) are not recommended by the medical community, although they are commonly used (Allkanjari & Vitalone, 2015). They may function by interfering with the conversion of testosterone to DHT. In addition, *S. repens* may directly block the ability of DHT to stimulate prostate cell growth. These agents should not be used with finasteride, dutasteride, or estrogen-containing medications (Allkanjari & Vitalone, 2015).

Surgical Management

Other treatment options include minimally invasive procedures and resection of the prostate gland.

Minimally Invasive Therapy

Several forms of minimally invasive therapy may be used to treat BPH. Transurethral microwave thermotherapy (TUMT) involves the application of heat to prostatic tissue. High-energy TUMT devices (CoreTherm, Prostatron, Targis) and low-energy devices (TherMatrx) are available (McDougal et al., 2016). A transurethral probe is inserted into the urethra, and microwaves are directed to the prostate tissue. The targeted tissue becomes necrotic and sloughs. To minimize damage to the urethra and decrease the discomfort from the procedure, some systems have a water-cooling apparatus.

Other minimally invasive treatment options include (transurethral needle ablation [TUNA]) by radiofrequency energy and the UroLume stent. TUNA uses low-level radiofrequencies delivered by thin needles placed in the prostate gland to produce localized heat that destroys prostate tissue while sparing other tissues. The body then reabsorbs the dead tissue. Prostatic stents are associated with significant complications (e.g., encrustation, infection, chronic pain); therefore, they are used only for patients with urinary retention and in patients who are poor surgical risks (McDougal et al., 2016).

Surgical Resection

Surgical resection of the prostate gland is another option for patients with moderate to severe lower urinary tract symptoms of BPH and for those with acute urinary retention or other complications. The specific surgical approach (open or endoscopic) and the energy source (electrocautery vs. laser) are based on the surgeon's experience, the size of the prostate gland, the presence of other medical disorders, and the patient's preference. If surgery is to be performed, all clotting defects must be corrected and medications for anticoagulation withheld because bleeding is a potential complication of prostate surgery.

Transurethral resection of the prostate (TURP) remains the benchmark for surgical treatment for BPH. It involves the surgical removal of the inner portion of the prostate through an endoscope inserted through the urethra; no external skin incision is made. It can be performed with ultrasound guidance. The treated tissue either vaporizes or becomes necrotic and sloughs. The procedure is performed in the outpatient setting and usually results in less postoperative bleeding than a traditional surgical prostatectomy.

Other surgical options for BPH include transurethral incision of the prostate (TUIP), transurethral electrovaporization, laser therapy, and open prostatectomy (Keane & Graham, 2016); (McDougal et al., 2016). TUIP is an outpatient procedure used to treat smaller prostates. One or two cuts are made in the prostate and prostate capsule to reduce constriction of the urethra and decrease resistance to flow of urine out of the bladder; no tissue is removed. Open prostatectomy involves the surgical removal of the inner portion of the prostate via a suprapubic, retropubic, or perineal (rare) approach for large prostate glands. Prostatectomy may also be performed laparoscopically or by robotic-assisted laparoscopy.

Nursing management of patients undergoing these procedures is described later in this chapter.

Cancer of the Prostate

Prostate cancer is the most common cancer in men other than nonmelanoma skin cancer. It is the second most common cause of cancer death in American men, exceeded only by lung cancer, and is responsible for 10% of cancer-related deaths in men. Among men diagnosed with prostate cancer, 98% survive at least 5 years, 84% survive at least 10 years, and 56% survive 15 years (ACS, 2015). There is paucity of data to precisely know the prevalence or incidence of prostate cancer in India. It was believed that the prevalence of prostate cancer is lower in India, but due to migration of rural people in cities, change in lifestyle, and increased availability of diagnostic facilities, now India is not too far from developed Western world (Jain, Saxena, S, & Kumar, 2014).

Prostate cancer is common in the United States and northwestern Europe but is rare in Africa, Central America, South America, China, and other parts of Asia. African American men have a high risk of prostate cancer; furthermore, they are more than twice as likely to die of prostate cancer as men of other racial or ethnic groups. Health care providers need to provide education about prostate cancer and appropriate screening in African American men, who are at higher risk compared to all other ethnic communities (Cremin, 2015). Health care providers should also ensure the delivery of culturally sensitive education programs and counseling about prostate cancer screening to not only the African American patient at risk for prostate cancer, but also to his friends and family (Mulheim, Fulbright, & Duncan, 2015).

The estimated age-adjusted incidence rate (AAR) of prostate cancer in India as a whole was $3.7/10^5$ persons during 2008. However, the regional variation of AAR was remarkable. It was found to be 0.8 in the state of Manipur (excluding Imphal) while in Delhi, the rate was $10.9/10^5$ person-years. The mean annual percentage change (MAPC) in the crude incidence rates ranged from 0.14 in Ahmedabad to 8.6 in Chennai (Hariharan & Padmanabha, 2016). Jain et al. (2014) also reported a wide variation in annual percentage change of prostate cancer in various population-based cancer registries of India, ranging from 3.4% in Bangalore to 11.6% in Kamrup District in Assam.

Other risk factors for prostate cancer include increasing age; the incidence of prostate cancer increases rapidly after the age of 50 years. More than 70% of cases occur in men older than 65 years. A familial predisposition may occur in men who have a father or brother previously diagnosed with prostate cancer, especially if their relatives were diagnosed at a young age. Genes that may be associated with increased risk of prostate cancer include hereditary prostate cancer 1 (*HPC1*) and *BRCA1* and *BRCA2* mutations (McDougal et al., 2016). The risk of prostate cancer is also greater in men whose diet contains excessive amounts of red meat or dairy products that are high in fat (ACS, 2015). Endogenous hormones, such as androgens and estrogens, also may be associated with the development of prostate cancer.

Clinical Manifestations

Cancer of the prostate in its early stages rarely produces symptoms. Usually, symptoms that develop from urinary obstruction occur in advanced disease. Prostate cancer tends to vary in its course. If the cancer is large enough to encroach on the bladder neck, signs and symptoms of urinary obstruction occur (difficulty and frequency of urination, urinary retention, and decreased size and force of the urinary stream). Other symptoms may include blood in the urine or semen and painful ejaculation. Hematuria may occur if the cancer invades the urethra or bladder. Sexual dysfunction is common before the diagnosis is made.

Prostate cancer can spread to lymph nodes and bone. Symptoms of metastases include backache, hip pain, perineal and rectal discomfort, anemia, weight loss, weakness, nausea, oliguria (decreased urine output), and spontaneous pathologic fractures. These symptoms may be the first indications of prostate cancer.

Assessment and Diagnostic Findings

If prostate cancer is detected early, the likelihood of cure is high (Itano et al., 2016). It can be diagnosed through an abnormal finding with the DRE, serum PSA, and ultrasound-guided TRUS with biopsy. Detection is more likely with the use of combined diagnostic procedures. Routine repeated DRE (preferably by the same examiner) is important because early cancer may be detected as a nodule within the gland or as an extensive hardening in the posterior lobe. The more advanced lesion is "stony hard" and fixed. DRE also provides useful clinical information about the rectum, anal sphincter, and quality of stool.

The diagnosis of prostate cancer is confirmed by a histologic examination of tissue removed surgically by TURP, open prostatectomy, or ultrasound-guided transrectal needle biopsy. Fine-needle aspiration is a quick, painless method of obtaining prostate cells for cytologic examination and determining the stage of disease.

Most prostate cancers are detected when a man seeks medical attention for symptoms of urinary obstruction or are found by routine DRE and PSA testing. Cancer detected incidentally when TURP is performed for clinically benign disease and lower urinary tract symptoms occurs in about 1 of 10 cases.

Nursing Alert: DRE and PSA testing are important screening procedures, because abnormal DRE and elevated levels of PSA may raise suspicion of prostate cancer. However, a diagnosis of cancer requires confirmation with a prostate biopsy.

TRUS helps detect nonpalpable prostate cancers and assists with staging of localized prostate cancer. Needle biopsies of the prostate are commonly guided by TRUS. The biopsies are examined by a pathologist to both determine if cancer is present and to grade the tumor. The most commonly used tumor grading system is the Gleason score. This system assigns a grade of 1 to 5 for the most predominant architectural pattern of the glands of the prostate and a secondary grade of 1 to 5 to the second most predominant pattern. The Gleason score is then reported as, for example, 2 + 4; the combined value can range from 2 to 10. With each increase in Gleason score, there is an increase in tumor aggressiveness. Lower Gleason scores indicate well-differentiated and less aggressive tumor cells; higher Gleason scores indicate undifferentiated cells and more aggressive cancer. A total score of 8 to 10 indicates a high-grade cancer (Keane & Graham, 2016).

Categorization of low-, intermediate-, and high-risk prostate cancer is determined by the extent of cancer in the prostate gland, whether or not the cancer is localized to the prostate, the aggressiveness of the cells, and the spread to the lymph nodes and beyond. Level of risk, in turn, is used to determine treatment options.

Bone scans, skeletal x-rays, and magnetic resonance imaging (MRI) may be used to identify metastatic bone disease. Pelvic computed tomography (CT) scans may be performed to determine if the cancer has spread to the lymph nodes. The radiolabeled monoclonal antibody capromab pendetide with indium 111 (ProstaScint) is an antibody that can be used to detect either recurrent prostate cancer at low PSA levels or metastatic disease (NCCN, 2016b).

Medical Management

Treatment is based on the patient's life expectancy, symptoms, risk of recurrence after definitive treatment, size of the tumor, Gleason score, PSA level, likelihood of complications, and patient preference. Therapy is often guided by the use of a nomogram or risk stratification scheme suggested by the NCCN (2016b) clinical practice guidelines. A multidisciplinary team approach is essential for the development of appropriate treatment. Management may be nonsurgical and involve watchful waiting or be surgical and entail prostatectomy. Nursing care of the patient with cancer of the prostate is summarized in Chart 46-3.

For patients with prostate cancer who choose nonsurgical watchful waiting, this approach involves actively monitoring the course of disease and intervening only if the cancer progresses or if symptoms warrant other intervention. It is an option for patients with life expectancy of less than 5 years and low-risk cancers. Advantages include absence of side effects of more aggressive treatment, improved quality of life, avoidance of unnecessary treatment, and decreased initial costs. Disadvantages include missed chance at cure, risk of metastasis, subsequent need for more aggressive treatment, anxiety about living with untreated cancer, and need for frequent monitoring (NCCN, 2016b); (Thakur, 2016).

Therapeutic vaccines kill existing cancer cells and provide long-lasting immunity against further cancer development. In 2010, the U.S. Food and Drug Administration (FDA) approved the first therapeutic cancer vaccine, sipuleucel-T (Provenge), for use in men with metastatic prostate cancer that is no longer responding to hormone therapy. In addition, two other medications, abiraterone acetate (Zytiga) and cabazitaxel

Chart 46-3 PLAN OF NURSING CARE

The Patient with Prostate Cancer

Nursing Diagnosis: Anxiety related to concern and lack of knowledge about the diagnosis, treatment plan, and prognosis
Goal: Reduced stress and improved ability to cope

Nursing Interventions	Rationale	Expected Outcomes
1. Obtain health history to determine the following: a. Patient's concerns b. His level of understanding of his health problem c. His past experience with cancer d. Whether he knows his diagnosis of malignancy and its prognosis e. His support systems and coping methods	1. Nurse clarifies information and facilitates patient's understanding and coping.	• Appears relaxed • States that anxiety has been reduced or relieved • Demonstrates understanding of illness, diagnostic tests, and treatment when questioned • Verbalizes adequate coping ability • Engages in open communication with others
2. Provide education about diagnosis and treatment plan. a. Explain in simple terms what diagnostic tests to expect, how long they will take, and what will be experienced during each test. b. Review treatment plan, and encourage patient to ask questions.	2. Helping the patient to understand the diagnostic tests and treatment plan will help decrease his anxiety and promote cooperation.	
3. Assess his psychological reaction to his diagnosis/prognosis and how he has coped with past stresses.	3. This information provides clues in determining appropriate measures to facilitate coping.	
4. Provide information about institutional and community resources for coping with prostate cancer: social services, support groups, community agencies.	4. Institutional and community resources can help the patient and family cope with the illness and treatment on an ongoing basis.	

Nursing Diagnosis: Urinary retention related to urethral obstruction secondary to prostatic enlargement or tumor and loss of bladder tone due to prolonged distention/retention
Goal: Improved pattern of urinary elimination

Nursing Interventions	Rationale	Expected Outcomes
1. Determine patient's usual pattern of urinary function.	1. Provides a baseline for comparison and goal to work toward.	• Voids at normal intervals • Reports absence of frequency, urgency, or bladder fullness • Displays no palpable suprapubic distention after voiding • Maintains balanced intake and output
2. Assess for signs and symptoms of urinary retention: amount and frequency of urination, suprapubic distention, complaints of urgency and discomfort.	2. Voiding 20–30 mL frequently and output less than intake suggest retention.	
3. Catheterize patient to determine amount of residual urine.	3. Determines amount of urine remaining in bladder after voiding.	
4. Initiate measures to treat retention. a. Encourage assuming normal position for voiding. b. Recommend using Valsalva maneuver preoperatively, if not contraindicated. c. Administer prescribed cholinergic agent. d. Monitor effects of medication.	4. Promotes voiding: a. Usual position provides relaxed conditions conducive to voiding. b. Valsalva maneuver exerts pressure to force urine out of bladder. c. Stimulates bladder contraction. d. If unsuccessful, another measure may be required.	
5. Consult with primary provider regarding intermittent or indwelling catheterization; assist with procedure as required.	5. Catheterization will relieve urinary retention until the specific cause is determined; it may be an obstruction that can be corrected only surgically.	

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6. Monitor catheter function; maintain sterility of closed system; irrigate as required.	6. Adequate functioning of catheter is to be ensured to empty bladder and to prevent infection.
7. Prepare patient for surgery if indicated.	7. Surgical removal of obstruction may be necessary.

Nursing Diagnosis: Deficient knowledge related to the diagnosis of: cancer, urinary difficulties, and treatment modalities
Goal: Understanding of the diagnosis and ability to care for self

Nursing Interventions	Rationale	Expected Outcomes
1. Encourage communication with the patient.	1. This is designed to establish rapport and trust.	• Discusses his concerns and problems freely • Asks questions and shows interest in his disorder • Describes activities that help or hinder recovery • Identifies ways of attaining/maintaining bladder control • Demonstrates satisfactory technique and understanding of catheter care • Lists signs and symptoms that must be reported should they occur (e.g., abnormal bleeding, infection)
2. Review the anatomy of the involved area.	2. Orientation to one's anatomy is basic to understanding its function.	
3. Be specific in selecting information that is relevant to the patient's particular treatment plan.	3. This is based on the treatment plan; because it varies with each patient, individualization is desirable.	
4. Identify ways to reduce pressure on the operative area after prostatectomy. a. Avoid prolonged sitting (in a chair, long automobile rides), standing, walking. b. Avoid straining, such as during exercises, bowel movement, lifting, and sexual intercourse.	4. This is to prevent bleeding; such precautions are in order for 6–8 weeks postoperatively.	
5. Familiarize patient with ways of attaining/maintaining bladder control.	5. These measures will help control frequency and dribbling and aid in preventing retention.	
a. Encourage urination every 2–3 hours; discourage voiding when supine.	a. By sitting or standing, patient is more likely to empty his bladder.	
b. Avoid drinking cola and caffeine beverages; urge a cutoff time in the evening for drinking fluids to minimize frequent voiding during the night.	b. Spacing the kind and amount of liquid intake will help to prevent frequency.	
c. Describe perineal exercises to be performed every hour.	c. Exercises will assist him in starting and stopping the urinary stream.	
d. Develop a schedule with patient that will fit into his routine.	d. A schedule will assist in developing a workable pattern of normal activities.	
6. Demonstrate catheter care; encourage his questions; stress the importance of position of urinary receptacle.	6. By requiring a return demonstration of care, collection, and emptying of the device, he will become more independent and also can prevent backflow of urine, which can lead to infection.	

Nursing Diagnosis: Imbalanced nutrition: less than body requirements related to decreased oral intake because of anorexia, nausea, and vomiting caused by cancer or its treatment
Goal: Maintain optimal nutritional status

Nursing Interventions	Rationale	Expected Outcomes
1. Assess the amount of food eaten.	1. This assessment will help determine nutrient intake.	• Responds positively to his favorite foods • Assumes responsibility for his oral hygiene • Reports absence of nausea and vomiting • Notes increase in weight after improved appetite
2. Routinely weigh patient.	2. Weighing the patient on the same scale under similar conditions can help monitor changes in weight.	
3. Elicit patient's explanation of why he is unable to eat more.	3. His explanation may present easily corrected practices.	

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4. Cater to his individual food preferences (e.g., avoiding foods that are too spicy or too cold).	4. He will be more likely to consume larger servings if food is palatable and appealing.
5. Recognize effect of medication or radiation therapy on appetite.	5. Many chemotherapeutic agents and radiation therapy promote anorexia.
6. Inform patient that alterations in taste can occur.	6. Aging and the disease process can reduce taste sensitivity. In addition, smell and taste can be altered as a result of the body's absorption of by-products of cellular destruction (brought on by malignancy and its treatment).
7. Educate patient about appropriate oral hygiene interventions	7. Food will be more palatable and appealing following good oral hygiene.
8. Use measures to control nausea and vomiting. a. Administer prescribed antiemetic agents, around the clock if necessary. b. Provide oral hygiene after vomiting episodes. c. Provide rest periods after meals.	8. Prevention of nausea and vomiting can stimulate appetite.
9. Provide frequent small meals and a comfortable and pleasant environment.	9. Smaller portions of food are less acute to the patient.
10. Assess patient's ability to obtain and prepare foods.	10. Disability or lack of social support can hinder the patient's ability to obtain and prepare foods.

Nursing Diagnosis: Sexual dysfunction related to effects of therapy: chemotherapy, hormonal therapy, radiation therapy, surgery
Goal: Ability to resume/enjoy modified sexual functioning

Nursing Interventions	Rationale	Expected Outcomes
1. Determine from nursing history what effect patient's medical condition is having on his sexual functioning.	1. Usually, decreased libido and, later, impotence may be experienced.	• Describes the reasons for changes in sexual functioning • Discusses with appropriate health care personnel alternative approaches and methods of sexual expression • Includes partner in discussions related to changes in sexual function
2. Inform patient of the effects of prostate surgery, orchiectomy (when applicable), chemotherapy, irradiation, and hormonal therapy on sexual function.	2. Treatment modalities may alter sexual function, but each is evaluated separately with regard to its effect on a particular patient.	
3. Include his partner in developing understanding and in discovering alternative, satisfying close relations with each other.	3. The bond between a couple may be strengthened with new appreciation and support that had not been evident before the current illness.	

Nursing Diagnosis: Acute pain related to progression of disease and treatment modalities
Goal: Relief of pain

Nursing Interventions	Rationale	Expected Outcomes
1. Evaluate nature of patient's pain, its location, and intensity using pain rating scale.	1. Determining nature and causes of pain and its intensity help to select proper pain relief modality and provide baseline for later comparison.	• Reports relief of pain • Expects exacerbations, reports their quality and intensity, and obtains relief • Uses pain relief strategies appropriately and effectively • Identifies strategies to avoid complications of analgesic use (e.g., constipation)
2. Avoid activities that aggravate or worsen pain.	2. Bumping the bed is an example of an action that can intensify the patient's pain.	
3. Because pain is usually related to bone metastasis, ensure that patient's bed has a bed board on a firm mattress. In addition, protect the patient from falls/injuries.	3. This will provide added support and is more comfortable. Protecting the patient from injury protects him from additional pain.	

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4. Provide support for affected extremities.	4. More support, coupled with reduced movement of the part, helps in pain control.	
5. Prepare patient for radiation therapy if prescribed.	5. Radiation therapy may be effective in controlling pain.	
6. Administer analgesic or opioid agents at regularly scheduled intervals as prescribed.	6. Analgesic agents alter perception of pain and provide comfort. Regularly scheduled analgesics around the clock rather than PRN (as needed) provide more consistent pain relief.	
7. Initiate bowel program to prevent constipation.	7. Opioid analgesic agents and inactivity contribute to constipation.	

Nursing Diagnosis: Impaired physical mobility related to tissue hypoxia, malnutrition, and exhaustion and to spinal cord or nerve compression from metastases
Goal: Improved physical mobility

Nursing Interventions	Rationale	Expected Outcomes
1. Assess for factors causing limited mobility (e.g., pain, hypercalcemia, limited exercise tolerance).	1. This information offers clues to the cause; if possible, cause is treated.	• Achieves improved physical mobility • Relates that short-term goals are encouraging him because they are attainable
2. Provide pain relief by administering prescribed medications.	2. Analgesic/opioid agents allow the patient to increase his activity more comfortably.	
3. Encourage the use of assistive devices: cane, walker.	3. Support may offer the security needed to become mobile.	
4. Involve significant others in helping patient with range-of-motion exercises, positioning, and walking.	4. Assistance from partner or others encourages patient to repeat activities and achieve goals.	
5. Provide positive reinforcement for achievement of small gains.	5. Encouragement stimulates improvement of performance.	
6. Assess nutritional status.	6. See Nursing Diagnosis: Imbalanced nutrition: less than body requirements.	

Collaborative Problems: Hemorrhage, infection, bladder neck obstruction
Goal: Absence of complications

Nursing Interventions	Rationale	Expected Outcomes
1. Alert the patient to changes that may occur (after discharge) and that need to be reported:	1. Certain changes signal beginning complications, which call for nursing and medical interventions.	• Experiences no bleeding or passage of blood clots • Reports no infection or pain around the catheter • Experiences normal frequency or urination • Reports normal urinary output • Maintains bladder control
a. Continued bloody urine; passing blood clots	a. Hematuria with or without blood clot formation may occur postoperatively.	
b. Pain; burning around the catheter	b. Indwelling urinary catheters may be a source of pain or infection.	
c. Frequency of urination	c. Urinary frequency may be caused by urinary tract infections or by bladder neck obstruction, resulting in incomplete voiding.	
d. Diminished urinary output	d. Bladder neck obstruction decreases the amount of urine that is voided.	
e. Increasing loss of bladder control	e. Urinary incontinence may be a result of urinary retention.	

(Jevtana injection) are treatments options for patients requiring care for the management of metastatic castration-resistant prostate cancer, which does not respond to sipuleucel-T or the usual treatment options (Simondsen & Kolesar, 2013).

Surgical Management

Radical prostatectomy is considered first-line treatment for prostate cancer and is used with patients whose tumor is confined to the prostate (McDougal et al., 2016). It is the complete surgical removal of the prostate, seminal vesicles, tips of the vas deferens, and often the surrounding fat, nerves, and blood vessels. Laparoscopic radical prostatectomy and robotic-assisted laparoscopic radical prostatectomy have become the standard surgical approaches for localized cancer of the prostate. Although sexual impotence is a common side effect, these laparoscopic radical prostatectomy approaches result in low morbidity and more favorable postoperative outcomes, including improved quality of life and less sexual dysfunction if the nerves are spared. Surgical approaches are discussed in detail later in this chapter.

Radiation Therapy

Two major forms of radiation therapy are used to treat cancer of the prostate: teletherapy (external) and brachytherapy (internal). Teletherapy (external-beam radiation therapy [EBRT]) is prescribed by the radiation oncologist for a total dose over a certain time frame—for example, 28 treatments over 5½ weeks (Itano et al., 2016). It is a treatment option for patients with low-risk prostate cancer; progression-free survival is similar to that of low-risk patients treated with radical prostatectomy. Patients with intermediate- and high-risk cancers receive higher doses of EBRT. They may also be candidates both pelvic lymph node irradiation and androgen deprivation therapy (ADT) that entails surgical (orchiectomy) or medical castration (e.g., with luteinizing hormone–releasing hormone agonists) (NCCN, 2016b). Intensity-modulated radiation therapy (IMRT) is one method of delivery of EBRT. IMRT sets a dose for the target volume and restricts the dose to surrounding tissue. Another approach to delivery of radiation uses a computer-controlled robotic arm to deliver a course of radiotherapy (i.e., stereotactic radiosurgery) to localized prostate cancer. This method, referred to as the CyberKnife®, is now considered a safe and reliable method of delivering radiation to treat prostate cancer (Detti, Bonomo, Masi, et al., 2016).

Brachytherapy involves the implantation of interstitial radioactive seeds under anesthesia. It has become a commonly used monotherapy treatment option for early, clinically organ-confined prostate cancer. The surgeon uses ultrasound guidance to place 80 to 100 seeds (depending on the prostate volume), and the patient returns home after the procedure. Exposure of others to radiation is minimal, but the patient should avoid close contact with pregnant women and infants for up to 2 months. Radiation safety guidelines include straining urine for seeds and using a condom during sexual intercourse for 2 weeks after implantation to catch any seeds that pass through the urethra. This approach can be completed in 1 day, with little lost time from normal activities. Brachytherapy may be combined with EBRT with or without neoadjuvant ADT for patients considered at intermediate risk. High-risk patients are considered poor candidates for permanent brachytherapy (Itano et al., 2016).

Although cure rates with radiation are comparable to those of radical prostatectomy, radiation therapy possesses its own unique set of side effects, which differ depending on the method of radiation administration. Patients receiving EBRT or brachytherapy may experience inflammation of the rectum, bowel, and bladder (proctitis, enteritis, and cystitis) because of the proximity of these structures to the prostate and the radiation doses. Inflammation and mucosal loss at the bladder neck, prostate, and urethra can cause acute urinary dysfunction. Both irritative and obstructive urinary symptoms can cause pain with urination and ejaculation until the irritation subsides. Rectal urgency, diarrhea, and tenesmus may occur as a result of radiation of the anterior rectal wall. Late side effects include rectal proctitis, bleeding, and rectal fistula; painless hematuria; chronic interstitial cystitis; urethral stricture erectile dysfunction; and, rarely, secondary cancers of the rectum and bladder (Thakur, 2016).

Hormonal Strategies

The number of survivors of prostate cancer in the United States is estimated at 2 million; approximately one third of these men currently receive ADT (Simpson, 2015). ADT is commonly used to suppress androgenic stimuli to the prostate by decreasing the level of circulating plasma testosterone or interrupting the conversion to or binding of DHT. As a result, the prostatic epithelium atrophies (decreases in size). This effect is accomplished either by surgical castration (bilateral orchiectomy, removal of one or both of the testes), which has traditionally been the mainstay of hormonal treatment, or by medical castration with the administration of medications, such as luteinizing hormone–releasing hormone (LHRH) agonists. Bilateral orchiectomy decreases plasma testosterone levels significantly because approximately 93% of circulating testosterone is of testicular origin (7% is from the adrenal glands). Thus, the testicular stimulus required for continued prostatic growth is removed, resulting in prostatic atrophy.

However, orchiectomy often results in significant morbidity. Although the procedure does not cause the side effects associated with other hormonal therapies (described later), it is associated with considerable emotional impact. Because patients who have prostate cancer are living longer with the disease, health care providers are focusing on effective therapeutic modalities that promote an acceptable quality of life. Patients may be given the option for testicular prostheses to be placed during surgery.

LHRH agonists include leuprolide (Lupron) and goserelin (Zoladex). Additional hormonal manipulation with antiandrogens may be prescribed for patients who do not show adequate serum testosterone suppression (less than 50 ng/mL) with medical or surgical castration. Antiandrogen receptor antagonists include flutamide (Eulexin), bicalutamide (Casodex), and nilutamide (Nilandron). LHRH agonists suppress testicular androgen, whereas antiandrogen receptor antagonists cause adrenal androgen suppression. When LHRH agonists are initiated, a testosterone flare may occur, causing pain in bony metastatic disease. Antiandrogens given for the first 7 days may reduce this uncomfortable symptom.

The most common uses of LHRH agonists are as follows: (1) in the adjuvant and neoadjuvant setting in combination with radiation therapy, (2) after radical prostatectomy, and (3) in the treatment of recurrence indicated by an elevation in the PSA but without clinical or x-ray evidence. Medical and surgical castration causes hot flushing because these treatment modalities increase hypothalamic activity, which stimulates the thermoregulatory centers of the body (Baker, 2014); (Jones, 2016); (Scher, 2016).

The management of hormone-refractory prostate cancer remains somewhat controversial. Another category of medication used as a second-line hormonal intervention is the adrenal ablating drugs. Ketoconazole (Nizoral) is used to inhibit cytochrome P450 enzymes, which are required for the synthesis of androgens and other steroids. High-dose ketoconazole lowers testosterone by decreasing both testicular and endocrine production of androgen. Administration of this medication requires steroid supplementation to prevent adrenal insufficiency.

Hypogonadism is responsible for the adverse effects of ADT, which include vasomotor flushing, loss of libido, decreased bone density (resulting in osteoporosis and fractures), anemia, fatigue, increased fat mass, lipid alterations, decreased muscle mass, gynecomastia (increased breast tissue), and mastodynia (breast/nipple tenderness). Hypogonadism is associated with an increased risk of diabetes, resulting from insulin resistance, metabolic syndrome, and cardiovascular disease (McDougal et al., 2016).

Chemotherapy

Recent studies have shown clear benefits in terms of survival with chemotherapy treatment that includes a docetaxel-based regimen for non–androgen-dependent prostate cancer (NCCN, 2016b). Other studies are under way to determine the importance of the vascular endothelial growth factor system. Tumor angiogenesis is essential for tumor growth, including growth of prostate carcinomas and other high-grade cancers. Therefore, antiangiogenic treatment in combination with conventional therapies may play a future role in treatment. Gene-based therapy in prostate cancer is an emerging and promising adjuvant to conventional treatment strategies.

Possible complications related to chemotherapy are specific to the type of chemotherapy given (see Chapter 58, Chart 58-4).

Other Therapies

Cryosurgery of the prostate is used to ablate prostate cancer in patients who cannot tolerate surgery and in those with recurrent prostate cancer. Transperineal probes are inserted into the prostate under ultrasound guidance to freeze the tissue directly.

Keeping the urethral passage patent may require repeated TURPs. If this is impractical, catheter drainage is instituted by way of the suprapubic or transurethral route. For men with advanced prostate cancer, palliative measures are indicated. Although cure is unlikely with advanced prostate cancer, many men survive for long periods, free of debilitating symptoms.

Bone lesions that result from metastasis of prostate cancer can be very painful and result in pathologic fractures. Opioid and nonopioid medications are used to control bone pain. EBRT can be delivered to skeletal lesions to relieve pain. Radiopharmaceuticals, such as strontium or samarium, can be injected IV to treat multiple sites of bone metastasis. Antiandrogen therapies are used in an effort to reduce the circulating androgens. If antiandrogen therapies are not effective, medications such as prednisone have been effective in reducing pain and improving quality of life (Lycken, Garmo, Adolfsson, et al., 2013); (Rathkopf & Scher, 2013). Bisphosphonate therapy with pamidronate (Aredia) can be given to reduce the risk of pathologic fracture. In advanced prostate cancer, blood transfusions are given to maintain adequate hemoglobin levels when bone marrow is replaced by tumor.

More than one third of men with a diagnosis of prostate cancer elect to use some form of complementary and integrative health. Acupuncture has been used to treat both PE and erectile dysfunction with some limited, anecdotal success (Tsai, Liu, Chang, et al., 2014). Because research on many forms of complementary, alternative, and integrative health is lacking, patients often rely on anecdotal information to make decisions about its use. Nurses and other health care professionals play a vital role in assisting patients to locate and evaluate available information about these practices to ensure that harmful forms are avoided (Braun, Gupta, Birdsall, et al., 2013). The National Center for Complementary and Integrative Health (NCCIH) website can assist nurses in providing patients with evidence-based information (see the Resources section at the end of the chapter).

The Patient Undergoing Prostate Surgery

Prostate surgery may be indicated for the patient with BPH or prostate cancer. The objectives before prostate surgery are to assess the patient's general health status and to establish optimal kidney function. Prostate surgery should be performed before acute urinary retention develops and damages the upper urinary tract and collecting system or, in the case of prostate cancer, before cancer progresses.

Surgical Procedures

Several approaches can be used to remove the hypertrophied portion of the prostate gland: TURP, suprapubic prostatectomy, perineal prostatectomy, retropubic prostatectomy, TUIP, and laparoscopic radical prostatectomy and robotic-assisted laparoscopic radical prostatectomy (see Table 46-4). With these approaches, all cancerous or hyperplastic tissue is removed, leaving behind only the capsule of the prostate.

Transurethral Resection of the Prostate

TURP, which is the most common procedure used, can be carried out through endoscopy. The prostate gland is removed in small chips with an electrical cutting loop (see Fig. 46-5A). This procedure eliminates the risk of transurethral resection syndrome (hyponatremia, hypovolemia). Transurethral resection syndrome is a potential but rare complication of TURP that occurs in approximately 2% of men who undergo the procedure (Lycken, et al., 2013); (Rathkopf & Scher, 2013) (see Chart 46-4).

TURP usually requires an overnight hospital stay. Urethral strictures are more frequent than with nontransurethral procedures, and repeated procedures may be necessary because the residual prostatic tissue grows back. TURP rarely causes erectile dysfunction but may trigger retrograde ejaculation, because removal of prostatic tissue at the bladder neck can cause the seminal fluid to flow backward into the bladder rather than forward through the urethra during ejaculation.

TABLE 46-4 Surgical Approaches for Treatment of Prostate Disorders

The surgical approach of choice depends on (1) the size of the gland, (2) the severity of the obstruction, (3) the age of the patient, (4) the condition of the patient, and (5) the presence of associated diseases.

Surgical Approach	Advantages	Disadvantages	Nursing Implications
Transurethral Resection (TURP) Removal of prostatic tissue by optical instrument introduced through urethra; used for glands of varying size. Ideal for patients who are poor surgical risks.	Avoids abdominal incision Safer for surgical-risk patient Shorter length of hospital stay and recovery periods Lower morbidity rate Causes less pain Can be used as a palliative approach with history of radiation therapy	Requires highly skilled surgeon. Recurrent obstruction, urethral trauma, and stricture may develop. Delayed bleeding may occur.	Monitor for hemorrhage. Observe for symptoms of urethral stricture (dysuria, straining, weak urinary stream).
Open Surgical Removal			
Suprapubic approach Removal of prostatic tissue through abdominal incision; can be used for gland of any size	Technically simple Offers wide area of exploration Permits exploration for cancerous lymph nodes Allows more complete removal of obstructing gland Permits treatment of associated bladder lesions	Requires surgical approach through the bladder Control of hemorrhage is difficult Urine may leak around the suprapubic tube Recovery may be prolonged and uncomfortable	Monitor for indications of hemorrhage and shock. Provide meticulous aseptic care to the area around suprapubic tube.
Perineal approach Removal of gland through an incision in the perineum; preferred approach for patients who are obese	Offers direct anatomic approach Permits gravity drainage Particularly effective for radical cancer therapy Allows hemostasis under direct vision Low mortality rate Low incidence of shock Ideal for patients with large prostate who are very old, frail, and poor surgical risks	Higher postoperative incidence of impotence and urinary incontinence Possible damage to rectum and external sphincter Restricted operative field Greater potential for contamination and infection of incision	Avoid using rectal tubes or thermometers and enemas after perineal surgery. Use drainage pads to absorb excess urinary drainage. Provide foam rubber ring for patient comfort in sitting. Anticipate urinary leakage around the wound for several days after the catheter is removed.
Retropubic approach Low abdominal incision; bladder is not entered.	Avoids incision into the bladder Permits surgeon to see and control bleeding Shorter recovery period Less bladder sphincter damage Suitable for removal of large glands	Cannot treat associated bladder disease Increased incidence of hemorrhage from prostatic venous plexus; osteitis pubis	Monitor for hemorrhage. Anticipate posturinary leakage for several days after removing the catheter.
Transurethral Incision (TUIP) Urethral approach; 1–2 cuts are made in the prostate and prostate capsule to reduce pressure on the urethra and to reduce urethral constriction.	Results comparable to TURP Low incidence of erectile dysfunction and retrograde ejaculation No bladder neck contracture	Recurrent obstruction and urethral trauma Delayed bleeding	Monitor for hemorrhage.
Laparoscopic Radical Prostatectomy In this approach, 4–6 small (1 cm [0.5 inch]) incisions are made in the abdomen; laparoscopic instruments inserted through the incisions are used to dissect the prostate.	Minimally invasive technique Improved patient satisfaction and quality of life Shorter length of hospital stay Short convalescence More rapid return to normal activity Short indwelling catheter duration Decreased blood loss to 400 mL Reduced infection risk Less scarring Better visualization of surgical field than other approaches	Lack of tactile sensation available with open prostatectomy Inability to palpably assess for induration and palpable nodules Inability to delineate the proximity of involvement of the neurovascular bundles due to lack of palpation Long surgical time (4–5 hours)	Observe for symptoms of urethral stricture (dysuria), straining, weak urinary stream. Monitor for hemorrhage and shock. Provide meticulous aseptic care to area around suprapubic tube. Monitor for changes in bowel function. Avoid using rectal tubes or thermometers and enemas after perineal surgery. Use drainage pads to absorb excess urinary drainage. Provide foam rubber ring for patient comfort in sitting. Anticipate urinary leakage around the wound for several days after the catheter is removed.

(Continued)

(Continued)

Robotic-Assisted Laparoscopic Radical Prostatectomy Involves using computer console and da Vinci. In this approach, 6 small (1 cm [0.5 inch]) incisions are made in the abdomen; laparoscopic instruments inserted through the incisions are used to dissect the prostate.	Minimally invasive technique Improved patient satisfaction and quality of life Shorter length of hospital stay Short convalescence More rapid return to normal activity Short indwelling catheter duration Decreased blood loss to 150 mL Improved magnification of operative field, using a 3-dimensional view (includes, magnification, high resolution, and depth perception) Less postoperative pain Reduced risk of infection Less scarring Laparoscopic instruments have 6 degrees of movement with joints, allowing extensive range of motion and precision. Nerve sparing with less incontinence and sexual dysfunction	Lack of tactile sensation available with open prostatectomy Inability to palpably assess for induration and palpable nodules Inability to delineate the proximity of involvement of the neurovascular bundles due to lack of palpation	Observe for symptoms of urethral stricture (dysuria), straining, weak urinary stream. Monitor for hemorrhage and shock. Provide meticulous aseptic care to the area around suprapubic tube. Monitor for changes in bowel function. Avoid using rectal tubes or thermometers and enemas after perineal surgery. Use drainage pads to absorb excess urinary drainage. Provide foam rubber ring for patient comfort in sitting. Anticipate urinary leakage around the wound for several days after the catheter is removed.

Adapted from Keane, T. E., & Graham, S. D. (Eds.) (2016). Glenn's urologic surgery. Philadelphia, PA: Wolters Kluwer; McDougal, W. J., Wein, A. J., Kavoussi, L. R., et al. (Eds.). (2016). Campbell-Walsh urology (11th ed.). Philadelphia, PA: Elsevier.

Chart 46-4

Transurethral Resection Syndrome

Transurethral resection syndrome is a rare but potentially serious complication of transurethral prostatectomy (TURP). Signs and symptoms are caused by neurologic, cardiovascular, and electrolyte imbalances associated with absorption of the solution used to irrigate the surgical site during the surgical procedure. Hyponatremia, hypovolemia, and occasionally hyperammonemia may occur.

Signs and Symptoms

- Collapse
- Headache
- Hypotension
- Lethargy and confusion
- Muscle spasms
- Nausea and vomiting
- Seizures
- Tachycardia

Interventions

- Discontinue irrigation.
- Administer diuretic agents as prescribed.
- Replace bladder irrigation with normal saline.
- Monitor intake and output.
- Monitor the patient's vital signs and level of consciousness.
- Differentiate lethargy and confusion of TURP syndrome from postoperative disorientation and hyponatremia.
- Maintain patient safety during times of confusion.
- Assess lung and heart sounds for indications of pulmonary edema, heart failure, or both as fluid moves back into the intravascular space.

Adapted from Brown, C. S. (2014). Dilutional hyponatremia in a community hospital setting: Case report. Intensive & Critical Care Nursing, 30(1), 1–5.

Suprapubic Prostatectomy

A suprapubic prostatectomy is an open surgical procedure (see Fig. 46-5B). Disadvantages include blood loss, the need for an abdominal incision, and the risks associated with any major abdominal surgical procedure (see Fig. 46-5B).

Perineal Prostatectomy

A perineal prostatectomy (see Fig. 46-5C) is practical when other approaches are not possible and is useful for an open biopsy. However, incontinence, sexual dysfunction, and rectal injury are more likely to occur with this approach.

Retropubic Prostatectomy

Retropubic prostatectomy is used more commonly than the suprapubic approach (see Fig. 46-5D). This procedure is suitable for large glands located high in the pelvis. Although blood loss can be better controlled and the surgical site is easier to visualize, infections can readily start in the retropubic space.

Transurethral Incision of the Prostate

TUIP is indicated when the prostate gland is small (30 g or less), and it is an effective treatment for many cases of BPH (see Fig. 46-5E). TUIP can be performed on an outpatient basis and has a lower complication rate than other more invasive prostate procedures.

Laparoscopic Radical Prostatectomy

A laparoscopic radical prostatectomy has fewer risks compared with open radical prostatectomy (Simpson, 2015).

Robotic-Assisted Laparoscopic Radical Prostatectomy

Robotic-assisted laparoscopic radical prostatectomy is a minimally invasive approach that uses a computer console and a robot to move instruments, replicating the movements of the surgeon's hands (Simpson, 2015); (Sohn, Lee, & Ahlering, 2013).

Pelvic Lymph Node Dissection

Pelvic lymph node dissection (PLND) is not always performed. It may be used in some patients to provide information for staging the tumor and to remove an area of microscopic metastasis. The planned treatment may influence the surgeon's

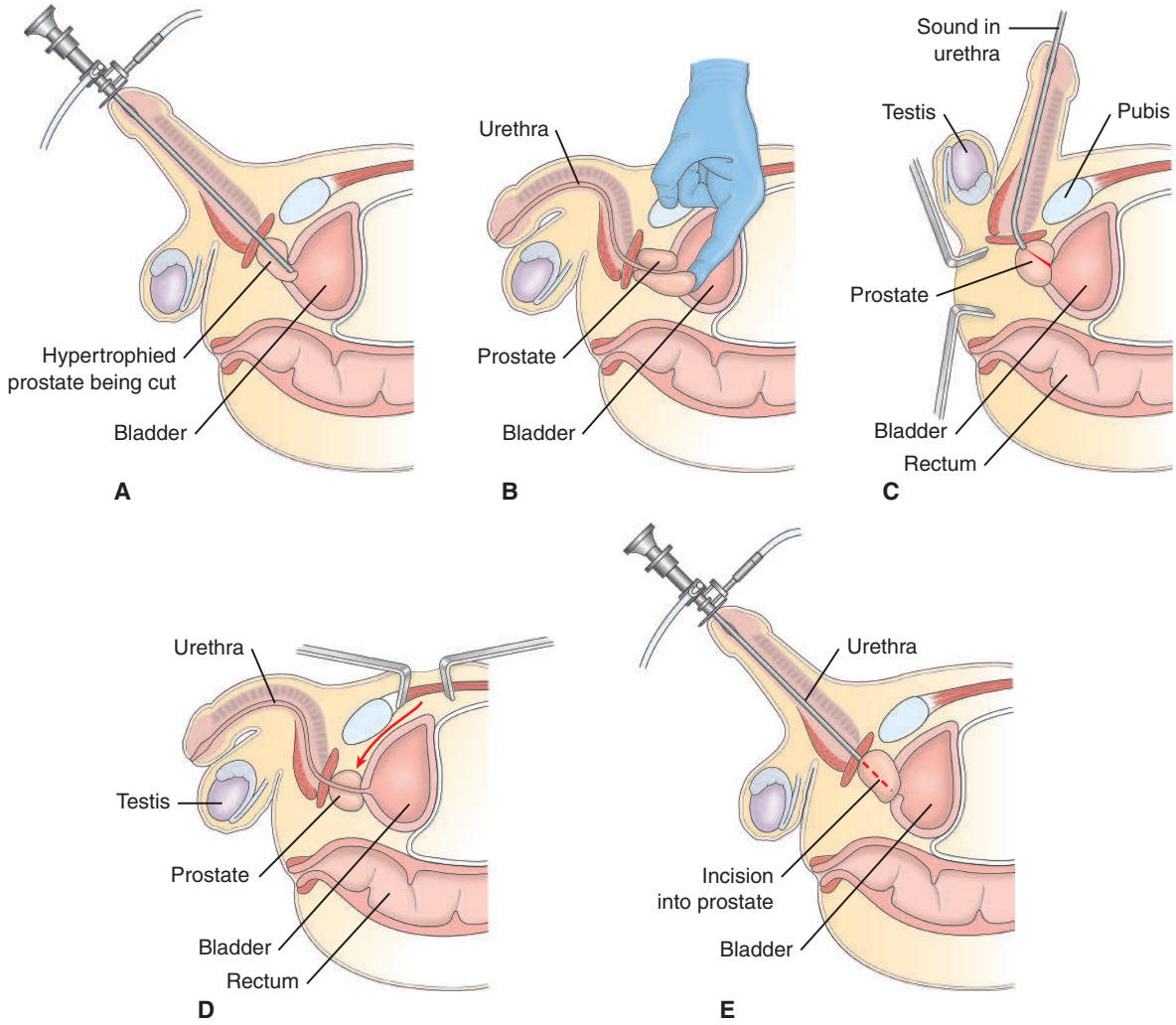


Figure 46-5 • Prostate surgery procedures. **A**. Transurethral resection of the prostate. A loop of wire connected with a cutting current is rotated in the cystoscope to remove shavings of prostate at the bladder orifice. **B**. Suprapubic prostatectomy. With an abdominal approach, the prostate is shelled out of its bed. **C**. Perineal prostatectomy. Two retractors on the left spread the perineal incision to provide a view of the prostate. **D**. Retropubic prostatectomy is performed through a low abdominal incision. Note two abdominal retractors and *arrow* pointing to the prostate gland. **E**. Transurethral incision of the prostate involves one or two incisions into the prostate to reduce pressure on the urethra.

decision to perform PLND and the extent (limited vs. extended) of the dissection. Dissection of nodes anterior and lateral to the external iliac vessels is associated with an increased risk of lymphedema (NCCN, 2016a).

Complications

Postoperative complications depend on the type of prostatectomy performed and may include hemorrhage, clot formation, catheter obstruction, and sexual dysfunction. All prostatectomies carry a risk of impotence because of potential damage to the pudendal nerves. In most instances, sexual activity may be resumed in 6 to 8 weeks, which is the time required for the prostatic fossa to heal. The anatomic changes in the posterior urethra can lead to retrograde ejaculation. During ejaculation, the seminal fluid goes into the bladder and is excreted with the urine. A vasectomy may be performed during surgery to prevent infection from spreading from the prostatic urethra through the vas and into the epididymis.

After total prostatectomy (usually for cancer), the risk of impotence is high. If this is unacceptable to the patient, options are available to produce erections sufficient for sexual intercourse: prosthetic penile implants, negative-pressure (vacuum) devices, and pharmacologic interventions (see earlier discussion and Table 46-2).

NURSING PROCESS

Patient Undergoing Prostatectomy

Assessment

The nurse assesses how the underlying disorder (BPH or prostate cancer) has affected the patient's lifestyle. Questions to ask during assessment include the following: Has the patient's activity level or activity tolerance changed? What is his presenting urinary problem (described in the patient's own words)? Has he experienced decreased force of urinary flow, decreased ability to initiate voiding, urgency, frequency, nocturia, dysuria, urinary retention, or hematuria? Does the patient report back pain, flank pain, and lower abdominal or suprapubic discomfort? Possible causes of such discomfort include infection, retention, and renal colic. Has the patient

experienced erectile dysfunction or changes in frequency or enjoyment of sexual activity?

The nurse obtains further information about the patient's family history of cancer and heart or kidney disease, including hypertension. Has he lost weight? Does he appear pale? Can he raise himself out of bed and return to bed without assistance? Can he perform usual activities of daily living? A comprehensive functional assessment helps determine how soon the patient will be able to return to normal activities after prostatectomy.

Diagnosis

Preoperative Nursing Diagnoses

Based on the assessment data, major preoperative nursing diagnoses may include the following:

- Anxiety about surgery and its outcome
- Acute pain related to bladder distention
- Deficient knowledge about factors related to the disorder and the treatment protocol

Postoperative Nursing Diagnoses

Based on the assessment data, major postoperative nursing diagnoses may include the following:

- Risk for imbalanced fluid volume
- Acute pain related to the surgical incision, catheter placement, and bladder spasms
- Deficient knowledge about postoperative care

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Hemorrhage and shock
- Infection
- Venous thromboembolism (VTE)
- Catheter obstruction
- Complications with catheter removal
- Urinary incontinence
- Sexual dysfunction

Planning and Goals

The major preoperative goals for the patient may include reduced anxiety and learning about his prostate disorder and the perioperative experience. The major postoperative goals may include maintenance of fluid volume balance, relief of pain and discomfort, ability to perform self-care activities, and absence of complications.

Preoperative Nursing Interventions

Reducing Anxiety

The patient is usually admitted to the hospital or surgical center on the morning of surgery. Because contact with the patient may be limited before surgery, the nurse must establish communication with the patient to assess his understanding of the diagnosis and of the planned surgical procedure. The nurse clarifies the nature of the surgery and expected postoperative outcomes. In addition, the nurse familiarizes the patient with the pre- and postoperative routines and initiates measures to reduce anxiety. Because the patient may be sensitive and embarrassed discussing problems related to the genitalia and sexuality, the nurse provides privacy and establishes a trusting and professional relationship. Guilt feelings often surface if the patient falsely assumes a cause-and-effect relationship between sexual practices and his current problems. He is encouraged to verbalize his feelings and concerns.

Relieving Discomfort

If the patient experiences discomfort before surgery, bed rest is prescribed, analgesic agents are given, and measures are initiated to relieve anxiety. If he is hospitalized, the nurse monitors his voiding patterns, watches for bladder distention, and assists with catheterization if indicated. An indwelling catheter is inserted if the patient has continuing urinary retention or if close monitoring is needed because of laboratory test results that indicate azotemia (accumulation of nitrogenous waste products in the blood). The catheter can help decompress the bladder gradually over several days, especially if the patient is an older adult and hypertensive and has diminished kidney function or urinary retention that has existed for many weeks. For a few days after the bladder begins draining, the blood pressure may fluctuate and kidney function may decline. If the patient cannot tolerate a urinary catheter, he is prepared for a cystostomy (and insertion of a suprapubic catheter).

Providing Education

Before surgery, the nurse reviews with the patient the anatomy of the affected structures and their function in relation to the urinary and reproductive systems, using diagrams and other educational aids as indicated. Web-based prostate cancer education both before and after surgery, along with phone and internet communication, promotes self-care management and support for patients and their partners and families (Song, Rini, Deal, et al., 2015). This education can occur during the preadmission testing visit, with the nurse in prescribed settings, or in the urologist's office. The nurse explains what will take place while the patient is prepared for diagnostic tests and then for surgery (depending on the type of prostatectomy planned). The nurse also reinforces information given by the surgeon about the type of incision, which varies with the surgical approach (see Table 46-4), and describes the likely type of urinary drainage system (urethral or suprapubic) and the recovery room procedure. The amount of information given is based on the patient's needs and questions. The nurse explains procedures expected to occur during the immediate perioperative period; answers questions the patient, family, or significant other may have; and provides emotional support. In addition, the nurse provides the patient with information about postoperative care and pain management.

Preparing the Patient

If the patient is scheduled for a prostatectomy, the preoperative preparation described in Chapter 4 is provided. Antiembolism stockings are applied before surgery and are particularly important to prevent VTE if the patient is placed in a lithotomy position during surgery. An enema is usually given at home on the evening before surgery or on the morning of surgery to prevent postoperative straining, which can induce bleeding.

Postoperative Nursing Interventions

Maintaining Fluid Balance

During the postoperative period, the patient is at risk for imbalanced fluid volume because of the irrigation of the surgical site during and after surgery. With irrigation of the urinary catheter to prevent its obstruction by blood clots, fluid may be absorbed through the open surgical site and retained, increasing the risk of excessive fluid retention, fluid imbalance, and water intoxication. The urine output and the amount of fluid used for irrigation must be closely monitored to determine whether irrigation fluid is being retained and to ensure an adequate urine output. An

intake and output record, including the amount of fluid used for irrigation, must be maintained. The patient is also monitored for electrolyte imbalances (e.g., hyponatremia), increasing blood pressure, confusion, and respiratory distress. These signs and symptoms are documented and reported to the surgeon. The risk of fluid and electrolyte imbalance is greater in older patients with pre-existing cardiovascular or respiratory disease.

Relieving Pain

After a prostatectomy, the patient is assisted to sit and dangle his legs over the side of the bed on the day of surgery. The next morning, he is assisted to ambulate. If pain is present, the cause and location are determined, and the severity of pain and discomfort is assessed (Carter, Miller, Murphy, et al., 2014). The pain may be related to the incision or may be the result of excoriation of the skin at the catheter site. It may be in the flank area, indicating a kidney problem, or it may be caused by bladder spasms. Bladder irritability can initiate bleeding and result in clot formation, leading to urinary retention.

Patients experiencing bladder spasms may report urgency to void, a feeling of pressure or fullness in the bladder, and bleeding from the urethra around the catheter. Medications that relax the smooth muscles can help ease the spasms, which can be intermittent and severe; these medications include flavoxate (Urispas) and oxybutynin (Ditropan). Warm compresses to the pubis or sitz baths may also relieve the spasms.

The nurse monitors the drainage tubing and irrigates the system as prescribed to relieve any obstruction that may cause discomfort. Usually, the catheter is irrigated with 50 mL of irrigating fluid at a time. It is important to make sure that the same amount is recovered in the drainage receptacle. Securing the catheter drainage tubing to the leg or abdomen can help decrease tension on the catheter and prevent bladder irritation. Discomfort may be caused by dressings that are too snug, saturated with drainage, or improperly placed. Analgesic agents are given as prescribed. The nurse notifies the primary provider if the analgesic medications do not relieve the patient's pain and obtains a prescription for new doses or different medications.

After the patient is ambulatory, he is encouraged to walk but not to sit for prolonged periods, because this increases intra-abdominal pressure and the possibility of discomfort and bleeding. Prune juice and stool softeners are provided to ease bowel movements and to prevent excessive straining. An enema, if prescribed, is given with caution to avoid rectal perforation.

Monitoring and Managing Potential Complications

After prostatectomy, the patient is monitored for major complications such as hemorrhage, infection, VTE, catheter problems, and sexual dysfunction.

Hemorrhage. Although patients are advised to discontinue all aspirin, nonsteroidal anti-inflammatory drugs, and platelet inhibitors 10 to 14 days before the surgery to prevent excessive bleeding, bleeding and hemorrhagic shock remain risks. The risk is increased with BPH because a hyperplastic prostate gland is very vascular. Bleeding may occur from the prostatic bed. Bleeding may also result in the formation of clots, which then obstruct urine flow. The drainage normally begins as reddish-pink and then clears to a light pink within 24 hours after surgery. Bright red bleeding with increased viscosity and numerous clots usually indicates arterial bleeding. Venous blood appears darker and less viscous. Arterial hemorrhage usually requires surgical intervention (e.g., suturing or transurethral coagulation of bleeding vessels), whereas venous bleeding may be controlled by applying prescribed traction to the catheter so that the balloon holding the catheter in place applies pressure to the prostatic fossa. The surgeon applies traction by securely taping the catheter to the patient's thigh if hemorrhage occurs. Less blood loss (150 mL) is expected with robotic-assisted laparoscopic radical prostatectomy, compared to the 500 to 900 mL loss that may occur with open prostatectomy.

Nursing management includes assistance in implementing strategies to stop the bleeding and to prevent or reverse hemorrhagic shock. If blood loss is extensive, fluids and blood component therapy may be given. If hemorrhagic shock occurs, treatments described in Chapter 8 are initiated.

Nursing interventions include closely monitoring vital signs; administering medications, IV fluids, and blood component therapy as prescribed; maintaining an accurate record of intake and output; and carefully monitoring drainage to ensure adequate urine flow and patency of the drainage system. The patient who experiences hemorrhage and his family are often anxious and benefit from explanations and reassurance about the event and the procedures that are performed.

Infection. After perineal prostatectomy, the surgeon usually changes the dressing on the first postoperative day. Further dressing changes may become the responsibility of the nurse in the inpatient setting or the home care nurse upon discharge. Careful aseptic technique is used because the potential for infection is great. Dressings can be held in place by a double-tailed, T-binder bandage or a padded athletic supporter. The tails cross over the incision to give double thickness and then each tail is drawn up on either side of the scrotum to the waistline and fastened.

Rectal thermometers, rectal tubes, and enemas are avoided because of the risk of injury and bleeding in the prostatic fossa. After the perineal sutures are removed, the perineum is cleansed as indicated. A heat lamp may be directed to the perineal area to promote healing. The scrotum is protected with a towel while the heat lamp is in use. Sitz baths are also used to promote healing.

UTIs and epididymitis are possible complications after prostatectomy. The patient is assessed for their occurrence; if they occur, the nurse administers antibiotic agents as prescribed. Because the risk of infection continues after discharge from the hospital, the patient and family need to be educated to monitor for signs and symptoms of infection (fever, chills, sweating, myalgia, dysuria, urinary frequency, and urgency). The patient and family are instructed to contact the urologist if these symptoms occur.

Venous Thromboembolism. Patients undergoing prostatectomy are at risk for VTE, including deep vein thrombosis and pulmonary embolism; therefore, the nurse assesses the patient frequently after surgery for manifestations of VTE. Early postoperative ambulation is essential to reduce the risk of VTE. Medical and nursing management of VTE are described in Chapters 12 and 24, respectively. In addition, if the patient is at high risk for clot formation, additional antithrombotic interventions may be prescribed (Goodman, 2013).

Potential Catheter Problems. After TURP, the catheter must drain well; an obstructed catheter produces distention of the prostatic capsule and resultant hemorrhage. Furosemide (Lasix) may be prescribed to promote urination and initiate postoperative diuresis, thereby helping to keep the catheter patent.

The nurse observes the lower abdomen to ensure that the catheter has not become blocked. A distinct, rounded swelling above the pubis is a manifestation of an overdistended bladder. If the nurse ascertains that the client's bladder is distended, a portable bladder scanner may be used to determine if urine retention is a problem (see Chapter 45).

The drainage bag is monitored for bloody urine, and the dressings and surgical incision are examined for bleeding. The color of the urine is carefully noted and documented; a change in color from pink to amber indicates reduced bleeding. Blood pressure, pulse, and respirations are monitored and compared with baseline preoperative vital signs to detect hypotension. The nurse also observes the patient for restlessness, diaphoresis, pallor, any drop in blood pressure, and an increasing pulse rate.

Drainage of the bladder may be accomplished by gravity through a closed sterile drainage system. A three-way drainage system is useful in irrigating the bladder and preventing clot formation (see Fig. 46-6). Continuous irrigation may be used with TURP. Some urologists leave an indwelling catheter attached to a dependent drainage system. Gentle irrigation of the catheter may be prescribed to remove any obstructing clots.

If the patient complains of pain, the tubing is examined. The drainage system is irrigated with irrigating fluid (usually 50 mL), if indicated and prescribed, to clear any obstruction.

Nursing Alert: The amount of fluid recovered in the drainage bag must equal the amount of fluid instilled. Overdistention of the bladder should be avoided because it can induce secondary hemorrhage by stretching the coagulated blood vessels in the prostatic capsule.

To prevent traction on the bladder, the drainage tube (not the catheter) is secured to the inner thigh. If a cystostomy catheter is in place, it is secured to the abdomen. The nurse explains the purpose of the catheter to the patient and assures him that the urge to void results from the presence of the catheter and from bladder spasms. Reassurance is given to the patient that medication (anticholinergics) will be given to control his bladder spasms. He is cautioned not to pull on the catheter, because this causes bleeding and subsequent catheter blockage, which leads to urinary retention.

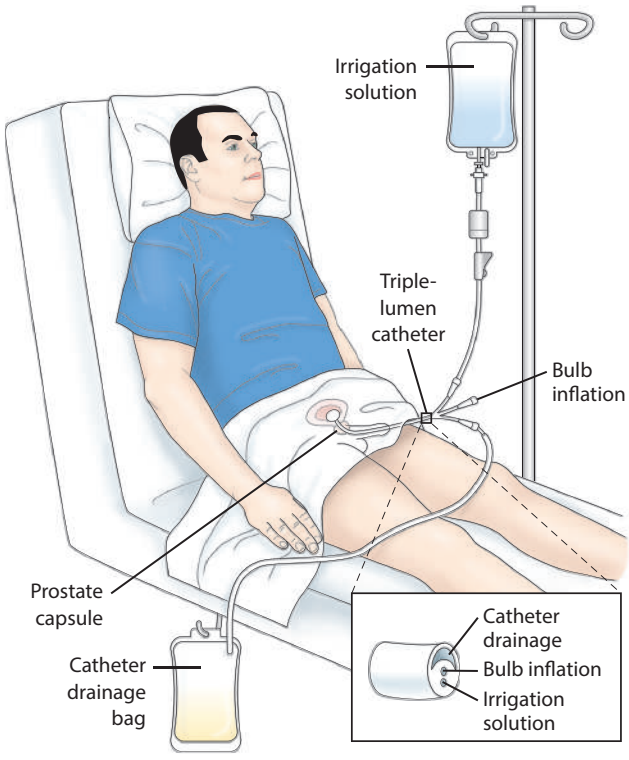


Figure 46-6 • A three-way system for bladder irrigation.

After the catheter is removed (usually when the urine appears clear), urine may leak around the wound for several days in the patient who has undergone perineal, suprapubic, or retropubic surgery. The cystostomy tube may be removed before or after the urethral catheter is removed. Some urinary incontinence may occur after catheter removal, and the patient is informed that this is likely to subside over time.

Urinary Incontinence. Postoperative urinary incontinence is a complication that can be reduced through the use of a surgical technique called puboprostatic ligament-sparing, or through the use of a male sling (Sandhu, 2015). Even without these techniques, current surgical procedures have decreased the incidence of urinary incontinence following surgery. Factors associated with postoperative continence are younger age, preservation of both neurovascular bundles, absence of an anastomotic stricture, eversion of the bladder neck, and a smaller prostate volume. The nurse can encourage the patient who experiences incontinence to take steps to prevent incontinence, improve continence, anticipate leakage, and cope with lack of complete control (Dorey, 2013). Preventing incontinence involves increasing voiding frequency, avoiding positions that encourage the urge to void, and decreasing fluid intake prior to activities. Promoting continence involves pelvic floor exercises (see the Educating Patients About Self-Care section that follows), biofeedback, and electrical stimulation. Anticipating leakage may entail lifestyle modifications such as using absorbent pads and carrying extra clothes to prevent urinary accidents; this can improve confidence when bathroom access is limited. It also helps to know the location of public bathrooms. Coping long term with complete lack of control may involve collagen injections, artificial sphincter implants, medications, and leg bags (Dorey, 2013); (McDougal et al., 2016).

Sexual Dysfunction. Depending on the type of surgery, the patient may experience sexual dysfunction related to erectile dysfunction, decreased libido, and fatigue. These issues may become a concern to the patient soon after surgery or in the weeks to months of rehabilitation. With nerve-sparing radical prostatectomy, the likelihood of recovering the ability to have erections is better for men who are younger and men in whom both neurovascular bundles are spared. A decrease in libido is usually related to the impact of the surgery on the body. Reassurance that the usual level of libido will return after recuperation from surgery is often helpful to the patient and his partner. The patient should be aware that he may experience fatigue during rehabilitation from surgery. This fatigue may also decrease his libido and alter his enjoyment of usual activities.

Several options to restore erectile function are discussed with the patient by the surgeon or urologist. These options may include medications, surgically placed implants, or negative-pressure devices. PDE-5 inhibitors (see Table 46-3) may be effective for treatment of erectile dysfunction in men after radical prostatectomy, especially if the neurovascular bundles have been preserved. They may also improve erectile

function in men with partial or moderate erectile dysfunction after radiation therapy for localized prostate cancer.

Nursing interventions include assessing for sexual dysfunction after surgery. Providing a private and confidential environment to discuss issues of sexuality is important. The emotional challenges of prostate surgery and its consequences need to be carefully explored with the patient and his partner. Providing the opportunity to discuss these issues can be very beneficial to the patient. For patients who have significant difficulty adjusting to sexual dysfunction, a referral to a sex therapist may be indicated.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. The length of the hospital stay for the patient undergoing prostatectomy depends on the surgical approach used and ranges from 1 to 2 days for robotic-assisted laparoscopic prostatectomy to 3 to 5 days for open prostatectomy. The patient and family require education about how to manage the drainage system, how to assess for complications, and how to promote recovery. The nurse provides verbal and written education about the need to maintain the drainage system and to monitor urinary output; about wound care; and about strategies to prevent complications, such as infection, bleeding, and thrombosis. In addition, the patient and family need to know about signs and symptoms that should be reported to the primary provider (e.g., blood in urine, decreased urine output, fever, change in wound drainage, calf tenderness).

As the patient recovers and drainage tubes are removed, he may become discouraged and depressed because he cannot regain bladder control immediately. Furthermore, urinary frequency and burning may occur after the catheter is removed. Educating the patient about the following exercises may help him regain urinary control:

- Tense the perineal muscles by pressing the buttocks together, hold this position, and then relax. This exercise can be performed 10 to 20 times each hour while sitting or standing (Itano et al., 2016).
- Try to interrupt the urinary stream after starting to void; wait a few seconds and then continue to void.

Perineal exercises should continue until the patient gains full urinary control. The patient is educated to urinate as soon as he feels the first urge to do so. It is important to let the patient know that regaining urinary control is a gradual process; he may continue to "dribble" after being discharged from the hospital, but this should gradually diminish (usually within 1 year). The urine may be cloudy for several weeks after surgery but should clear as the prostate area heals.

While the prostatic fossa heals (6 to 8 weeks), the patient should avoid activities that produce Valsalva effects (straining, heavy lifting) because they may increase venous pressure and produce hematuria. He should avoid long motor trips and strenuous exercise, which increase the tendency to bleed. He should also know that spicy foods, alcohol, and coffee may cause bladder discomfort. The patient should be cautioned to drink enough fluids to avoid dehydration, which increases the tendency for a blood clot to form and obstruct the flow of urine. Signs of complications, such as bleeding, passage of blood clots, a decrease in the urinary stream, urinary retention, or symptoms of UTIs, should be reported to the primary provider (see Chart 46-5). Patients who have undergone robotic-assisted prostatectomy are often able to return to their usual activities in approximately 7 to 10 days (Sohn et al., 2013).

Continuing and Transitional Care. Referral for home, community-based or transitional care may be indicated if the patient is an older adult or has other health problems, if the patient and family cannot provide care in the home, or if the patient lives alone without available supports. The nurse making a home visit assesses the patient's physical status (cardiovascular and respiratory status, fluid and nutritional status, patency of the urinary drainage system, wound and nutritional status) and provides catheter and wound care, if

Chart 46-5 HOME CARE CHECKLIST

Postprostatectomy Care

At the completion of home care education, the patient and/or caregiver will be able to:

- Name the procedure that was performed and identify any permanent changes in anatomic structure or function as well as changes in ADLs, IADLs, roles, relationships, and spirituality.
- Locate list of names and telephone numbers of resource personnel involved in care (e.g., health care professionals, home care nurse, urinary catheter/dressing supply vendor).
- Identify the equipment necessary and how to obtain medical supplies to carry out dressing changes, wound care, and other prescribed regimens.
- Describe ongoing postoperative therapeutic regimen, including diet and activities to perform (e.g., increased activity and ambulation, perineal exercises) and to limit or avoid (e.g., lifting weights, driving a car, contact sports).
  - Describe measures to relieve postoperative pain and discomfort (e.g., take analgesics as prescribed; use nonpharmacologic interventions).
  - Demonstrate appropriate care of urinary catheter and collection receptacle.
  - Demonstrate appropriate dressing change/wound care.
  - When appropriate, demonstrate performance of perineal muscle exercises to facilitate bladder control.
- State the name, dose, side effects, frequency, and schedule for all medications.
- Identify signs and symptoms of complications that should be reported to surgeon (e.g., decreased output, blood or clots in urine or urine drainage system, change in wound drainage, fever or symptoms of urinary tract infections, calf tenderness).
- Explain treatment plan and importance of follow-up care to all health care providers.
- State time and date of follow-up appointments, therapy, and testing.
- Identify community resources for peer and caregiver/family support:
  - Identify sources of support (e.g. friends, relatives, faith community).
  - Identify phone numbers of support groups for people with cancer and their caregivers/families.
  - State meeting locations and times for support groups.
- Identify the need for health promotion, disease prevention, and screening activities.

ADL, activities of daily living; IADL, independent activities of daily living.

indicated. The nurse reinforces previous education, assesses the ability of the patient and family to manage required care, and encourages the patient to ambulate and to carry out perineal exercises as prescribed. The patient may need to be reminded that return of bladder control may take time.

The patient is reminded about the importance of routine health screening and other health promotion activities. If the prostatectomy was performed to treat prostate cancer, the patient and family are also instructed about the importance of follow-up and monitoring with the primary provider.

Evaluation

Expected preoperative patient outcomes may include:

1. Demonstrates reduced anxiety
2. States that pain and discomfort are decreased
3. Relates understanding of the surgical procedure and postoperative course and practices perineal muscle exercises and other techniques useful in facilitating bladder control

Expected postoperative patient outcomes may include the following:

1. Reports relief of discomfort
2. Exhibits fluid and electrolyte balance
   a. Irrigation fluid and urinary output are within parameters determined by surgeon
   b. Experiences no signs or symptoms of fluid retention
3. Participates in self-care measures
   a. Increases activity and ambulation daily
   b. Produces urine output within normal ranges and consistent with intake
   c. Performs perineal exercises and interrupts urinary stream to promote bladder control
   d. Avoids straining and lifting heavy objects
4. Is free of complications
   a. Maintains vital signs within normal limits
   b. Exhibits wound healing, without signs of inflammation or hemorrhage
   c. Maintains acceptable level of urinary elimination
   d. Maintains optimal drainage of catheter and other drainage tubes
   e. Reports understanding of changes in sexual function

DISORDERS AFFECTING THE TESTES AND ADJACENT STRUCTURES

Orchitis

Orchitis is a rare, acute inflammatory response of one or both testes as a complication of systemic infection or as an extension of an associated epididymitis caused by bacterial, viral, spirochetal, or parasitic organisms. Micro-organisms may reach the testes through the blood, lymphatic system, or, more commonly, by traveling through the urethra, vas deferens, and epididymis; bacteria usually spread from an associated epididymitis in sexually active men. Causative organisms include *Neisseria gonorrhoeae, Chlamydia trachomatis, E. coli, Klebsiella, Pseudomonas aeruginosa, Staphylococcus* species, and *Streptococcus* species.

Signs and symptoms of orchitis include fever; pain, which may range from mild to severe; tenderness in one or both testicles; bilateral or unilateral testicular swelling; penile discharge; blood in the semen; and leukocytosis.

Treatment of orchitis is based on whether the causative organism is bacterial or viral. Bacterial orchitis is treated with antibiotic agents and supportive comfort measures. If the cause of the orchitis is an STI, the partner should be treated as well. Viral orchitis is treated using supportive treatments of rest, elevation of the scrotum, ice packs to reduce scrotal edema, analgesic agents, and anti-inflammatory medications. Bilateral orchitis can cause sterility in some men. Mumps vaccination is recommended for postpubertal men who have not had mumps or received inadequate immunization in childhood. Orchitis develops in approximately 30% of postpubertal men with mumps 4 to 6 days after parotitis starts, and one third of men have some testicular atrophy.

Epididymitis

Epididymitis is an infection of the epididymis, which usually spreads from an infected urethra, bladder, or prostate. The incidence is less than 1 in 1000 males per year. Prevalence is greatest in men 19 to 35 years of age. Acute epididymitis occurs bilaterally in 5% to 10% of affected patients (McDougal et al., 2016). Risk factors for epididymitis include recent surgery or a procedure involving the urinary tract, participation in high-risk sexual practices, personal history of an STI, past prostate infections or UTIs, lack of circumcision, history of an enlarged prostate, and the presence of a chronic indwelling urinary catheter.

Pathophysiology

A causative organism can be identified in 80% of patients. In prepubertal males, older men, and men who are homosexual, the predominate causal organism is *E. coli,* although in older men, the condition may also be a result of urinary obstruction. In sexually active men 35 years and younger, the pathogens usually are related to bacteria associated with STIs (e.g., *C. trachomatis, N. gonorrhoeae*). The infection moves in an upward direction, through the urethra and the ejaculatory duct, and then along the vas deferens to the epididymis (Taylor, 2015).

Clinical Manifestations

Epididymitis often slowly develops over 1 to 2 days, beginning with a low-grade fever, chills, and heaviness in the affected testicle. The testicle becomes increasingly tender to pressure and traction. The patient may report unilateral pain, soreness in the inguinal canal along the course of the vas deferens, and pain and swelling in the scrotum and the groin. The epididymis becomes increasingly swollen, with extreme pain in the lower abdomen and pelvis. Occasionally, there may be discharge from the urethra, blood in the semen, pus (pyuria) and bacteria (bacteriuria) in the urine, and pain during intercourse and ejaculation. The patient may report urinary frequency, urgency, or dysuria, and testicular pain aggravated by bowel movement.

Assessment and Diagnostic Findings

Laboratory assessment includes urinalysis, complete blood cell count, Gram stain of urethral drainage, urethral culture or deoxyribonucleic acid (DNA) probe, and referral for syphilis and HIV testing in sexually active patients. Acute testicular pain should never be ignored, and it should be distinguished from testicular torsion, which is a surgical emergency.

Medical Management

The selection of an antibiotic depends on the causative organism; if epididymitis is associated with an STI, the patient's partner should also receive antimicrobial therapy. The spermatic cord may be infiltrated with a local anesthetic agent to relieve pain if the patient is seen within the first 24 hours after onset of pain. Supportive interventions also include reduction in physical activity, scrotal support and elevation, ice packs, anti-inflammatory agents, analgesics (including nerve blocks), and sitz baths. Urethral instrumentation (e.g., catheter insertion) is avoided. The patient is observed for scrotal abscess formation as well.

In chronic epididymitis, a 4- to 6-week course of antibiotic therapy for bacterial pathogens is prescribed. An epididymectomy (excision of the epididymis from the testis) may be performed for patients who have recurrent, refractory, incapacitating episodes of this infection. With long-term epididymitis, the passage of sperm may be obstructed. If the obstruction is bilateral, infertility may result.

Nursing Management

Bed rest is prescribed, and the scrotum is elevated with a scrotal bridge or folded towel to prevent traction on the spermatic cord, to promote venous drainage, and to relieve pain. Antimicrobial agents are given as prescribed until the acute inflammation subsides. Intermittent cold compresses to the scrotum may help ease the pain. Later, local heat or sitz baths may help resolve the inflammation. Analgesic medications are given for pain relief as prescribed.

The nurse instructs the patient to avoid straining, lifting, and sexual stimulation until the infection is under control. He should continue taking analgesic agents and antibiotics as prescribed and using ice packs if necessary to relieve discomfort. He needs to know that it may take 4 weeks or longer for the inflammation to resolve.

Testicular Torsion

Testicular torsion is a surgical emergency requiring immediate diagnosis to avoid loss of the testicle. Torsion of the testis is rotation of the testis, which twists the blood vessels in the spermatic cord and therefore impedes the arterial and venous supply to the testicle and surrounding structures in the scrotum. The patient presents with sudden pain in the testicle, developing over 1 to 2 hours, with or without a predisposing event. Nausea, lightheadedness, and swelling of the scrotum may develop. On physical examination, testicular tenderness, an elevated testis, a thickened spermatic cord, and a swollen, painful scrotum may be present. If the torsion cannot be reduced manually, surgery to untwist the spermatic cord and anchor both testes in their correct position to prevent recurrence should occur within 6 hours of the onset of symptoms in order to save the testis. After 6 hours of impaired blood supply, the risk of loss of the testicle increases.

Testicular Cancer

Although only accounting for about 1% of all cancers in men, testicular cancer is the most common cancer diagnosed in men between 15 and 35 years of age; approximately 8400 new cases and 380 deaths occur in the United States annually (ACS, 2015). It is the second most common malignancy in those 35 to 39 years of age. For unknown reasons, worldwide incidence of testicular tumors has more than doubled in the past 40 years. Testicular cancer incidence rates are highest in developed countries such as New Zealand (7.8), UK (6.3), Australia (6.1), Sweden (5.6), USA (5.2), Poland (4.9), and Spain (3.8) per 100,000 men. India has the lowest incidence—0.5 per 100,000 men (Shanmugalingam, Soultati, Chowdhury, et al., 2013). Because of advances in cancer therapy, testicular cancer is a highly treatable and usually curable form of cancer. The 5-year relative survival rate for all testicular cancers is more than 95% and approaches 99% if the cancer has not spread outside of the testes (ACS, 2015). After treatment, most patients with testicular cancer have a near-normal life expectancy.

Classification of Testicular Tumors

The testicles contain several types of cells, each of which may develop into one or more types of cancer. The type of cancer cell determines the appropriate treatment and affects the prognosis. Testicular cancer is classified as germinal or nongerminal (stromal). Secondary testicular cancers may also occur.

Germinal Tumors

Germinal tumors make up approximately 90% of all cancers of the testis; germinal tumors are further classified as seminomas or nonseminomas. These cancers grow from the germ cells that produce sperm, thus the name *germinal tumors.* Seminomas are slow-growing forms of testicular cancer that are usually found in men in their 30s and 40s (ACS, 2015); (NCCN, 2016c). Although seminomas can spread to the lymph nodes, the cancer is usually localized in the testes. Nonseminomas are more common and tend to grow more quickly than seminomas. Nonseminomas are often made up of different cell types and are identified according to the cells in which they start to grow. Nonseminoma testicular cancers include choriocarcinomas (rare), embryonal carcinomas, teratomas, and yolk sac tumors. It is crucial to distinguish between seminomas and nonseminomas because the differences affect prognosis and treatment.

Nongerminal Tumors

Nongerminal tumors account for less than 10% of testicular cancers. These cancers may develop in the supportive and hormone-producing tissues, or stroma, of the testicles. The two main types of stromal tumors are Leydig cell tumors and Sertoli cell tumors. Although these tumors infrequently spread beyond the testicle, a small number metastasize and tend to be resistant to chemotherapy and radiation therapy.

Secondary Testicular Tumors

Secondary testicular tumors are those that have metastasized to the testicle from other organs. Lymphoma is the most common cause of secondary testicular cancer. Cancers may also spread to the testicles from the prostate gland, lung, skin (melanoma), kidney, and other organs. The prognosis with these cancers is usually poor because they typically also spread to other organs. Treatment depends on the specific type of cancer (ACS, 2015).

Risk Factors

Risk factors for testicular cancer include cryptorchidism (undescended testicles), family history of testicular cancer, and personal history of testicular cancer (ACS, 2015); (Fuller, 2014). Other risk factors include race and ethnicity: Caucasian American men have a five times greater risk than African American men and more than two to three times greater

risk than Asian, Native American, and Hispanic American men. The risk of developing testicular cancer is higher in HIV-positive men (ACS, 2015). Occupational hazards, including exposure to chemicals encountered in mining, oil and gas production, and leather processing, have been suggested as possible risk factors. No evidence has linked testicular cancer to prenatal exposure to diethylstilbestrol or to vasectomy (ACS, 2015).

Clinical Manifestations

The symptoms appear gradually, with a mass or lump on the testicle and usually painless enlargement of the testis. The patient may report heaviness in the scrotum, inguinal area, or lower abdomen. Backache (from retroperitoneal node extension), abdominal pain, weight loss, and general weakness may result from metastasis. Enlargement of the testis without pain is a significant diagnostic finding. Some testicular tumors tend to metastasize early, spreading from the testis to the lymph nodes in the retroperitoneum and to the lungs.

Assessment and Diagnostic Findings

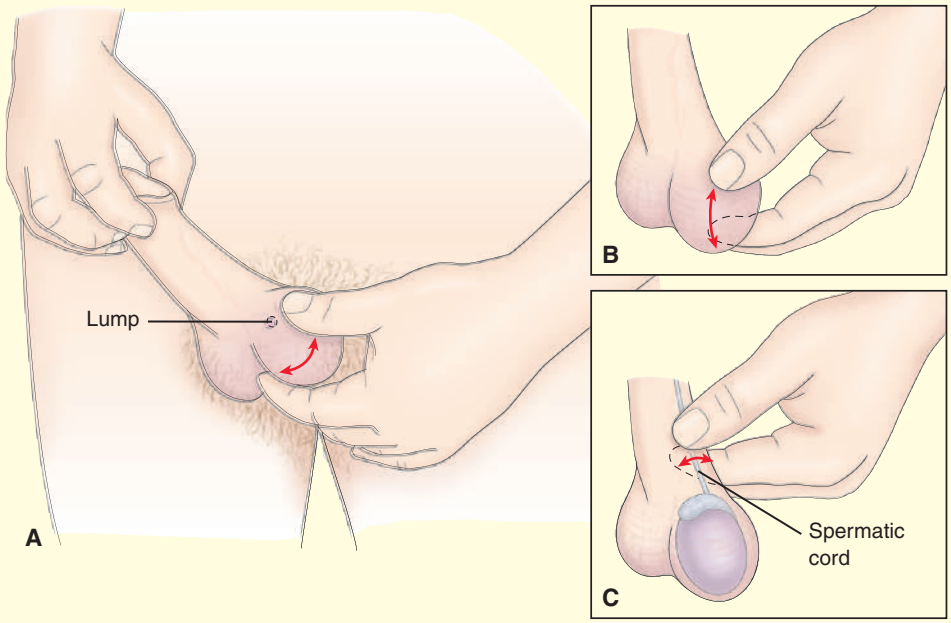
Educating young men about testicular cancer and the need for urgent evaluation of any mass or enlargement or unexplained testicular pain is key to early detection (Fuller, 2014). Education about TSE, starting in adolescence, alerts men to the importance of seeking medical attention if a testicle becomes indurated, enlarged, atrophied, nodular, or painful (see Chart 46-6). TSE should be performed monthly. Testicular cancers generally grow rapidly and are easily detected against a typically smooth and homogeneous texture. Annual testicular examination by a clinician can reveal signs and lead to early diagnosis and treatment of testicular cancer. Promoting awareness of this disease is an important health promotion intervention; men should seek medical evaluation for signs or symptoms of testicular cancer without delay (Akar & Bebis, 2014). Any suspicious testicular mass warrants prompt evaluation with a thorough history and physical examination, focusing on palpation of the affected testicle.

The tumor markers alpha-fetoprotein (AFP) and beta-human chorionic gonadotropin (beta-hCG) may be elevated in patients

Chart 46-6 PATIENT EDUCATION

Testicular Self-Examination

Testicular self-examination is to be performed once a month. The test is neither difficult nor time-consuming. A convenient time is usually after a warm bath or shower when the scrotum is more relaxed.



The nurse instructs the patient to:

1. Use both hands to palpate the testis. The normal testicle is smooth and uniform in consistency.
2. Place the index and middle fingers under the testis and the thumb on top; roll the testis gently in a horizontal plane between the thumb and fingers (**A**).
3. Feel for any evidence of a small lump or abnormality.
4. Follow the same procedure and palpate upward along the testis (**B**).
5. Locate and palpate the epididymis (**C**), a cordlike structure on the top and back of the testicle that stores and transports sperm. In addition, locate and palpate the spermatic cord.
6. Repeat the examination for the other testis, epididymis, and spermatic cord. It is normal to find that one testis is larger than the other.
7. If you find any evidence of a small, pealike lump or if the testis is swollen (possibly from an infection or tumor), consult your primary provider.

Adapted from Weber, J. R., & Kelley, J. H. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

with testicular cancer. Tumor marker levels in the blood are used for diagnosis, staging, and monitoring the response to treatment. Blood chemistry, including lactate dehydrogenase, is also necessary.

A chest x-ray to assess for metastasis in the lungs and a transscrotal testicular ultrasound will be performed. Microscopic analysis of tissue is the only definitive way to determine if cancer is present, but it is usually performed at the time of surgery rather than as a part of the diagnostic workup to reduce the risk of promoting spread of the cancer (ACS, 2015). Inguinal orchiectomy is the standard way to establish the diagnosis of testicular cancer. Other staging tests to determine the extent of the disease in the retroperitoneum, pelvis, and chest include an abdominal/pelvic CT scan and chest CT scan (if the abdominal CT or chest x-ray is abnormal). A brain MRI and bone scan may be obtained if indicated (NCCN, 2016c). Discussion of the option to bank sperm should take place prior to orchiectomy and treatment.

Medical Management

Testicular cancer—one of the most curable solid tumors—is highly responsive to treatment. Early-stage disease is curable more than 95% of the time; thus, prompt diagnosis and treatment are essential. The NCCN practice consensus guidelines for testicular cancer are used to guide diagnostic workup, primary treatment, follow-up, and salvage therapy (treatment given when the cancer does not respond to standard treatment) for both seminomas and nonseminomas (NCCN, 2016c). The goals of management are to eradicate the disease and achieve a cure. Therapy is based on the cell type, the stage of the disease, and risk classification tables (determined as good, intermediate, and poor risk). Primary treatment includes removal of the affected testis by orchiectomy through an inguinal incision with a high ligation of the spermatic cord. The patient is offered the option of implantation of a testicular prosthesis during the orchiectomy. Although most patients experience no impairment of endocrine function after unilateral orchiectomy for testicular cancer, some patients have decreased hormonal levels, suggesting that the unaffected testis is not functioning normally. Retroperitoneal lymph node dissection (RPLND) may be performed after orchiectomy to diagnose and prevent lymphatic spread of the cancer. Alternatives to the more invasive open RPLND for early-stage germ cell testicular cancer include nerve-sparing and laparoscopic RPLND, which improve sexual function and promote rapid recovery (Hanna & Einhorn, 2014). Although libido and orgasm are usually unimpaired after RPLND, ejaculatory dysfunction with resultant infertility may develop. Two thirds of men who are newly diagnosed with testicular cancer may be considering future fatherhood, and sperm quality is reduced in men with testicular cancer; therefore, sperm banking before treatment may be considered (Martin, Turner, Bourne, et al., 2013). Half of patients will not recover fertility as a result of radiation therapy, cytotoxic therapy, unilateral excision of a testis, and RPLND. Counseling about fertility issues may help the patient make the appropriate choices (Brand, Williams, & Braybrooke, 2015).

Radiation therapy is more effective with seminomas than with nonseminomas. Postoperatively, radiation may be used in early-stage seminomas. It is delivered only to the affected side; the other testis is shielded from radiation to preserve fertility. Radiation is also used in patients whose disease does not respond to chemotherapy and in those for whom lymph node surgery is not recommended.

Chemotherapy may be used for seminomas, nonseminomas, and advanced metastatic disease. Cisplatin (Platinol-AQ) can be used in combination with other chemotherapeutic agents, such as etoposide (Toposar), bleomycin (Blenoxane), paclitaxel (Taxol), ifosfamide (Ifex), and vinblastine (Velban), and results in a high percentage of complete remissions. With nonseminomas, aggressive surgical resection of all residual masses following chemotherapy is standard therapy. Good results may also be obtained by combining different types of treatment, including surgery, radiation therapy, and chemotherapy. Even with metastatic testicular cancer, the prognosis is favorable because of advances in treatment. However, for patients who do not respond to high-dose salvage chemotherapy, the cancer is nearly always incurable.

A patient with a history of one testicular tumor has a greater chance of developing subsequent tumors. Late relapse of testicular cancer is currently defined as tumor recurrence more than 2 years after complete remission following primary treatment that included chemotherapy. The most common site of recurrence is the retroperitoneum. Follow-up studies include chest x-rays, excretory urography, radioimmunoassay of beta-hCG and AFP levels, and examination of lymph nodes.

Long-term side effects associated with treatment for testicular cancer include renal insufficiency from kidney damage, hearing problems, gonadal damage, peripheral neuropathy, and, rarely, secondary cancers. Management of a patient with testicular carcinoma is therapy aimed at cure followed by close monitoring to detect and promptly treat any recurrences (NCCN, 2016c). Investigations of new medications, combinations of chemotherapeutic agents, and stem cell transplantation are ongoing.

Nursing Management

Nursing management includes assessment of the patient's physical and psychological status and monitoring of the patient for response to and possible effects of surgery, chemotherapy, and radiation therapy (see Chapter 58). Pre- and postoperative care is described in Chapters 4 and 6, respectively. In addition, because the patient may have difficulty coping with his condition, issues related to body image and sexuality should be addressed.

Patients may be required to endure a long course of therapy and will need encouragement to maintain a positive attitude. After completing treatment, patients enter a follow-up surveillance period. Nurses educate these cancer survivors about the importance of adhering to follow-up appointments for early detection of cancer recurrence (most often occurring within 2 years posttreatment) and evaluation of late effects of treatment (including secondary cancers). Additional concerns include infertility, cardiotoxicity, neurotoxicity, nephrotoxicity, pulmonary toxicity, and metabolic syndrome; and alterations in quality of life (Russell, 2014); (Schover, van der Kaaij, van Dorst, et al., 2014). The nurse carefully assesses cultural aspects of care related to testicular cancer and its treatment (see Chart 46-7). The nurse reminds the patient about the importance of performing TSE in the treated or remaining testis. The patient is encouraged to participate in healthy behaviors, including smoking cessation, healthy diet, minimization of alcohol intake, and cancer screening activities. Most experts agree that couples should use birth control for 18 to 24 months after the last cycle of chemotherapy as this is the usual period of time after treatment for sperm to return to normal (Brand et al., 2015).

Chart 46-7 NURSING RESEARCH PROFILE

Surviving Testicular Cancer

Saab, M., Noureddine, S., Hujer, H. A., et al. (2014). Surviving testicular cancer: The Lebanese lived experience. Nursing Research, 63(3), 203–209.

Purpose

There is limited research and other literature available about what it means to live with testicular cancer. Although there are a few studies on survivors of testicular cancer in the United States and in several other European countries, there are no studies on men residing in the Arab region, particularly men in the country of Lebanon. The purpose of this study was to describe the experience of Lebanese survivors of testicular cancer and to obtain an understanding of the psychosexual dimensions of their experience.

Design

A hermeneutic, phenomenologic, qualitative research design was used to interview eight men recruited from the clinics of a urologist and an oncologist. The inclusion criteria specified that the participant: (1) was a resident of Lebanon who was of Lebanese nationality, as it was believed that the participant's cultural background played a major role in shaping their experiences, (2) was between 18 and 50 years of age, (3) was amenable to sharing personal information about the experience, (4) was willing to consent to digitally recording the interview, and (5) was willing to provide informed consent. A purposive sampling method was used. Prior to initiating the interview, the researcher asked several icebreaker questions about the participant's state of health and engagement in various types of daily activities. The main interview question was: Tell me about your life since you were diagnosed with testicular cancer. Specifically, the researchers asked participants about their lives since being diagnosed and receiving treatment, about their personal relationships, how their sex life, fertility, and sexual performance was affected, and if any problems were occurring. To ensure privacy for the interview, the researcher met with the men in a place of the participant's choice. Interviews were conducted in the participants' homes, workplaces, researcher's office, and one was held by participant request in the researcher's car. After each interview field notes were written by the researcher.

Findings

The study participants were 32–50 years of age, with a mean age of 41 years. The participants were interviewed approximately 6 years after they had completed treatment. Five men reported undergoing a unilateral orchiectomy with chemotherapy, two reported only a bilateral orchiectomy, and one had a bilateral orchiectomy with radiation therapy. The participants were primarily businessmen, managers, skilled workers, an engineer and a bank employee. Six participants were married and two were identified as single. Six themes emerged from the interview data: (1) cancer perception in the Lebanese culture, (2) "do not show, do not tell," (3) the cancer experience is a turning point, (4) fertility, manhood and relationships, (5) coping with cancer, (6) preserved aspects of life.

Nursing Implications

It is important for nurses and other health care providers to address the patients' need for education and the cultural aspects of care related to testicular cancer and its treatment. The topics of fertility and sexuality must be included in all educational programs since these two topics were major areas of concern to the participants. Since fertility was a key determinant to the man's sexual identity, the need to discuss the option of sperm banking was viewed as an important care recommendation. The need for support groups with possible contact between newly diagnosed men and testicular cancer survivors, sexual counseling, and instruction on testicular self-examination during adolescence and young adulthood were important components to integrate into health care practice.

Hydrocele

A hydrocele is a collection of fluid most commonly located between the visceral and parietal layers of the tunica vaginalis of the testis, although it may also collect within the spermatic cord. This condition is the most common cause of scrotal swelling. At birth, 1 in 10 infants has a hydrocele, which usually resolves without treatment within the first year of life. Acute hydroceles primarily develop in adults older than 40 years; they may occur in association with inflammation (e.g., radiation therapy), infection, epididymitis, local injury, or systemic infectious disease (e.g., mumps). Chronic hydroceles may occur related to the imbalance between fluid secretion and reabsorption in the tunica vaginalis. On physical examination, an easily transilluminated, painless, extratesticular mass is found. Hydrocele can be differentiated from a hernia by transillumination; a hydrocele transmits light, whereas a hernia does not. Ultrasonography is recommended for large hydroceles to differentiate them from testicular tumors (Crawford, 2014).

Treatment is usually not required unless the hydrocele is large, bulky, tense, or uncomfortable; compromises testicular circulation; or causes an undesirable appearance. Treatment may involve surgical excision or needle aspiration. Surgical excision (hydrocelectomy) may be performed in an outpatient setting under general or spinal anesthesia with the goal of prevention of recurrence by excising the tunica vaginalis or sclerosing the visceral and parietal layers. Surgical excision involves resection or suturing together the two layers. A drainage tube may be required, and the patient is advised to wear a bulky dressing over the incisional site for a few days after the procedure. To reduce swelling, ice packs are applied to the scrotal area during the first 24 hours. A scrotal athletic supporter may be worn for a period of time postoperatively for comfort and support. Surgical risks include hematoma in the loose scrotal tissues, infection, or injury to the scrotum.

Needle aspiration is another option used to remove the fluid in the scrotum. Because it is common for fluid to reaccumulate, this treatment may be followed by the injection of a sclerosing agent to prevent this recurrence. This option may be used for men who are poor surgical risks. Potential risks include infection and scrotal pain.

Varicocele

A varicocele is an abnormal dilation of the pampiniform venous plexus and the internal spermatic vein in the scrotum (the network of veins from the testis and the epididymis, which constitute part of the spermatic cord). Varicoceles occur in approximately 15% to 20% of healthy adult men and 40% of infertile men; the large majority (95%) are in the left testicle because incompetent valves are more common in the left internal

spermatic veins (Grossman & Porth, 2014). Although men may report scrotal pain, tenderness, heaviness in the inguinal area, and infertility, varicoceles are often asymptomatic.

If the varicocele is mild and fertility is not an issue, no treatment is required, and a scrotal support is usually sufficient to relieve symptoms of heaviness. If the condition results in ongoing distressing symptoms or fertility is an issue, the varicocele can be corrected surgically. Postprocedural education and care include an ice pack applied to the scrotum for the first few hours after surgery to relieve edema, dressing removal after 48 hours, nonstrenuous exercise for the first 2 days, scrotal support, pain control, and reporting complications such as infection and hematoma.

Vasectomy

Vasectomy, or male sterilization, involves the surgical interruption of both vas deferens—the tubes that carry the sperm from the testicles and epididymis to the seminal vesicles—to prevent fertilization of an egg after ejaculation. During the outpatient procedure, the surgeon exposes the vas deferens through a small surgical opening or puncture in the scrotum using a sharp, curved hemostat (see Fig. 46-7). The vas is then ligated (cut) or cauterized (burned), with the severed ends occluded by ties or clips to seal the lumens and then placed back into the scrotum. A section of the vas deferens may or may not be removed. The spermatozoa, which are manufactured in the testes, cannot travel up the vas deferens after this surgery (McDougal et al., 2016).

Because seminal fluid is manufactured predominantly in the seminal vesicles and prostate gland, which are unaffected by vasectomy, no noticeable decrease in the amount of ejaculate occurs (volume decreases approximately 3%), even though it contains no spermatozoa. Because the sperm cells have no exit, they are resorbed into the body. A vasectomy usually has no effect on sexual potency, erection, ejaculation, or production of male hormones and provides no protection against STIs.

Couples who were once worried about pregnancy resulting from contraceptive failure often report a decrease in concern and an increase in spontaneous sexual arousal after vasectomy. Concise and factual preoperative explanations may minimize or relieve the patient's concerns related to pain and reduced masculinity. The patient is advised that he will be sterile but that potency will not be altered after a bilateral vasectomy. On rare occasions, a spontaneous reanastomosis of the vas deferens occurs, making it possible to impregnate a partner.

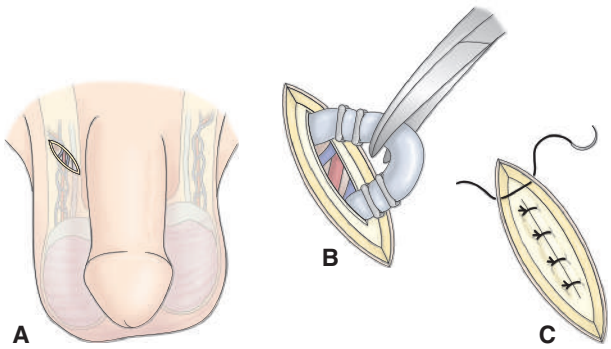


Figure 46-7 • A vasectomy is a resection of the vas deferens to prevent passage of sperm from the testes to the urethra during ejaculation. **A**. An incision or small puncture is made to expose the vas deferens. **B**. The vas deferens is isolated and severed. **C**. The severed ends are occluded with ligatures or clips, or the lumen of each vas is sealed by electrocautery and the incision is sutured closed. (Suturing may not be required if a puncture approach has been used.)

Complications of vasectomy include scrotal ecchymoses and swelling, superficial wound infection, vasitis (inflammation of the vas deferens), epididymitis or epididymo-orchitis, hematomas, chronic pain, and spermatic granuloma. A spermatic granuloma is an inflammatory response to the collection of sperm leaking from the severed end of the proximal vas deferens into the scrotal tissue. A painless small lump is formed, which usually does not require surgical intervention.

Nursing Management

Nursing education focuses on self-management of swelling and discomfort post vasectomy. Applying ice bags intermittently to the scrotum for several hours after surgery can reduce swelling and relieve discomfort. The nurse advises the patient to wear snug cotton underwear or a scrotal support for added comfort and support. Explanation of expected discoloration of the scrotal skin and superficial swelling may alleviate anxiety and concerns. These conditions may be relieved by sitz baths.

Sexual intercourse may be resumed as desired, usually after 1 week. Fertility remains for a varying time after vasectomy until the spermatozoa stored distally in the seminal vesicles have been evacuated. Sterility is often achieved after 10 to 20 ejaculations following the vasectomy procedure but may take longer. A reliable method of contraception should be used until infertility is confirmed by examination of an ejaculate specimen in the urologist's office at a follow-up appointment, usually 4 to 8 weeks after the vasectomy.

Vasovasostomy (Sterilization Reversal)

Although men choosing to undergo vasectomy should not consider the surgical procedure as reversible, microsurgical techniques can be used to reverse a vasectomy (vasovasostomy) and restore patency to the vas deferens. Many men have sperm in their ejaculate after a reversal, and 50% to 70% can impregnate a partner. The success of the procedure depends on the vasectomy method performed and the amount of time since the vasectomy. The procedure can be very costly, is not covered by insurance, is not permanent with occlusion of the vas recurring 2 or more years after vasovasostomy, and results in sperm counts at lower than prevasectomy levels (Lindsey, Herrela, Goodman, et al., 2015).

Semen Cryopreservation (Sperm Banking)

Storing fertile semen in a sperm bank before a vasectomy is an option for men who experience a major life change and may want to father a child at a later time. In addition, if a man has just sustained an injury to the spinal cord or is about to undergo a procedure or treatment (e.g., radiation therapy to the pelvis, chemotherapy, orchiectomy) that may affect his fertility, sperm banking may be considered (Kelvin, 2015). This procedure usually requires several visits to the facility where the sperm is stored under hypothermic conditions. The semen is obtained by masturbation and collected in a sterile container for storage. Insurance carriers rarely cover the cost of semen collection and banking. The costs of semen cryopreservation vary according to facility, method of sperm retrieval, number of specimens, and length of time in storage, making the process cost-prohibitive for some men.

DISORDERS AFFECTING THE PENIS

Phimosis

Phimosis is a condition in which the foreskin (prepuce) cannot be retracted over the glans in uncircumcised males. With the decrease in routine circumcision of newborns, early instruction should be given to parents about cleansing the foreskin and the need for retraction to cleanse the glans. If the glans is not cleaned, secretions accumulate, causing inflammation of the glans penis (balanitis), which can later lead to adhesions and fibrosis. Phimosis often develops in adults as a result of inflammation, edema, and constriction because of poor hygiene or underlying medical conditions such as diabetes. The thickened secretions (smegma) can become encrusted with urinary salts and calcify, forming calculi in the prepuce and increasing the risk of penile carcinoma. Treatment for phimosis secondary to inflammation is the application of steroidal cream to the foreskin to soften and correct the narrowness, resulting in decreased constriction. Although phimosis is the most common indication for adult circumcision, it is rarely necessary to surgically correct the condition by loosening or removing the foreskin.

Paraphimosis is a condition in which the foreskin, once retracted over the glans, cannot be returned to its usual position. Chronic inflammation under the foreskin leads to formation of a tight ring of skin when the foreskin is retracted behind the glans, causing venous congestion, edema, and enlargement of the glans, which makes the condition worse. As the condition progresses, arterial occlusion and necrosis of the glans may occur. Paraphimosis usually can be treated by firmly compressing the glans for 5 minutes to reduce the tissue edema and size and then pushing the glans back while simultaneously moving the foreskin forward (manual reduction). The constricting skin ring may require incision under local anesthesia. Circumcision is usually indicated after the inflammation and edema subside (Keane & Graham, 2016).

Cancer of the Penis

Penile cancer is rare, occurring in less than 1% of cancers among men in the United States. It accounts for an estimated 1290 new cancer cases and 300 expected deaths each year (ACS, 2015). The 5-year survival rates for cancer localized to the penis approaches 80%, but this statistic drops to 52% if the lymph nodes are involved and to 18% if the cancer has spread beyond the inguinal lymph nodes (Keane & Graham, 2016). Penile cancer is much more common in some parts of Africa and South America, where it accounts for up to 10% of cancers in men. In rural India, the rate of penile cancer is higher (3/100000 men) than in urban population (0.7-2.3/100000), which accounts more than 6% of all cancers in Indian population.

Because the penis contains different cell types, penile cancer can arise in each type of cell, which determines the prognosis. Types of penile cancer include squamous cell carcinoma (most common; 95% of cases), epidermoid penile cancer, verrucous carcinoma, adenocarcinoma, in situ carcinomas (erythroplasia of Queyrat and Bowen disease), basal cell penile cancer, melanoma, and sarcomas (McDougal et al., 2016). Several risk factors for penile cancer have been identified, including lack of circumcision, poor genital hygiene, phimosis, HPV, smoking, ultraviolet light treatment of psoriasis on the penis, increasing age (two thirds of cases occur in men older than 65 years), penile metastasis secondary to bladder cancer, lichen sclerosus, and balanitis xerotica obliterans (Kumar, Bhattacharyya, Mandal, et al., 2014); (Turner, Drudge-Coates, & Henderson, 2013). However, the exact cause remains unclear. Because penile cancer is rare, there has been little improvement in diagnostic and staging tests, understanding of risk factors, and development of treatment modalities.

Clinical Manifestations

The penile lesion usually alerts the patient to the presence of penile cancer; however, men may delay seeking treatment for more than a year because of embarrassment, fear, or lack of understanding. Common clinical presentations are a painless lump, ulcer, or wartlike growth on the skin of the penis; a change in skin color such as a red rash, bluish growths, or whitish patches; and malodorous and persistent discharge in late stages.

Assessment and Diagnostic Findings

Penile cancer involves the glans most frequently (48%), followed by lesions of the foreskin (21%), the coronal sulcus (6%), the penile shaft (less than 2%), the urethra, and regional or distant lymph nodes (McDougal et al., 2016). A thorough physical examination is necessary, including assessment and palpation of the penis and the inguinal lymph nodes. The size, location, borders, consistency, fixation, and character and time of onset of the penile lesions should be noted. Incisional or excisional biopsy is performed to determine the cell types of the penile cancer. Further staging tests using ultrasonography, MRI, or CT scan may be obtained to determine the extent of local lesions, if metastatic disease is present, and treatment options.

Prevention

The best way to reduce the risk of penile cancer is to avoid known risk factors whenever possible (ACS, 2015). Avoidance of sexual practices that are likely to result in HPV infection may reduce the risk of penile cancer. Gardasil, a vaccine that protects against infection with HPV, the cause of 90% of genital warts, is recommended for males 9 through 26 years old (CDC, 2015). Although uncircumcised men have a greater incidence of penile cancer than circumcised men, the more important factor in preventing penile cancer is good genital hygiene. Circumcision is not recommended as a prevention strategy (ACS, 2015).

Medical Management

Treatment varies depending on the type and stage of penile cancer, location of the lesion, overall physical health, and personal preferences about treatments and side effects. Treatment emphasis is on minimizing the cancer's invasiveness and preserving organ function (Khoo, 2013). The goal of treatment in invasive penile cancer is complete excision with adequate margins. Surgery is the most common treatment method used in all forms of the disease. Depending on the stage and invasiveness of the cancer, therapeutic options may include simple excision, electrodesiccation and curettage, cryosurgery, Mohs surgery (microscopically controlled surgery), yttrium aluminum garnet (YAG) laser surgery, wide local excision, circumcision, and surgical removal of part of the penis or the entire penis (penectomy). Organ-sparing surgical approaches are preferable. Partial penectomy is preferred to total penectomy because patients can then participate in sexual intercourse, stand for urination, and maintain cosmesis.

Modern reconstructive surgical techniques are providing more options for patients. The shaft of the penis can still respond to sexual arousal with an erection and has the sensory capacity for orgasm and ejaculation. Total penectomy is indicated if the tumor is not amenable to conservative treatment. After a total penectomy, the patient may still experience orgasm with stimulation of the perineum and scrotal area.

Topical chemotherapy with 5-fluorouracil cream or biologic therapy may also be effective. Radiation therapy is used to treat small squamous cell carcinomas of the penis and for palliation in advanced tumors or cases of lymph node metastasis.

Penile cancer spreads primarily to the inguinal lymph nodes; thus, appropriate lymph node management plays a significant role in survival. Because enlarged inguinal lymph nodes are caused by inflammation in 50% of cases, patients who present with enlarged lymph nodes should undergo treatment of the primary lesion followed by a 4- to 6-week course of oral broad-spectrum antibiotic agents. Persistent enlarged lymph nodes after antibiotic therapy should be considered to be metastatic disease and treated with either a sentinel lymph node biopsy (to determine presence of cancer) or with pelvic and bilateral inguinal lymph node dissection. If extensive pelvic lymph node involvement is present, the patient should receive adjuvant or neoadjuvant chemotherapy and postoperative radiation therapy (Khoo, 2013).

Priapism

Priapism, a relatively uncommon disorder, is defined as a persistent penile erection that may or may not be related to sexual stimulation. The penis becomes large, hard, and painful. Priapism results from either neural or vascular causes, including sickle cell disease, leukemic cell infiltration, polycythemia, spinal cord tumors or injury, and tumor invasion of the penis or its vessels. It may also occur with use of vasoactive agents that affect the central nervous system, antihypertensive agents, antipsychotic and antidepressant medications, substances injected into the penis to treat erectile dysfunction, alcohol, and cocaine. There are three forms of priapism: ischemic (veno-occlusive; low flow), nonischemic (high flow), and stuttering (intermittent).

The ischemic form, which is described as nonsexual, persistent erection with little or no cavernous blood flow, must be treated promptly to prevent permanent damage to the penis. The goal of therapy is to improve venous drainage of the corpora cavernosa to prevent ischemia, fibrosis, and impotence. The initial treatment is directed at relieving the erection, preventing penile damage and simultaneously treating the underlying disease. Recommended treatment is aspiration of the corpora cavernosa (with or without irrigation) or intracavernous injection of sympathomimetic agents (e.g., phenylephrine). Repeated injections may be needed to resolve priapism. Surgical shunts are used to reestablish penile circulation if repeated injections of the sympathomimetic are ineffective (McDougal et al., 2016).

Nonischemic priapism and stuttering are generally not considered emergencies and often resolve without treatment. Conservative treatment (e.g., application of ice and site-specific compression to the injury) may be used. If repeated episodes occur, surgical shunting is considered. Patients with the intermittent form of priapism may be instructed in intracavernosal self-injection of phenylephrine.

Peyronie's Disease

Peyronie's disease is an acquired, benign condition that involves the buildup of fibrous plaques in the sheath of the corpus cavernosum. These plaques are not visible when the penis is relaxed. However, when the penis is erect, curvature occurs that can be painful and can make sexual intercourse difficult or impossible. Peyronie's disease typically begins between 45 and 65 years of age. Medical management in the first year of active disease includes systemic, topical, intralesional, or extracorporeal techniques, with 50% of men experiencing spontaneous resolution. Surgical removal of mature plaques is used to treat severe disease. Patients should be fully informed of available treatment options and their likely outcomes (McDougal et al., 2016).

Urethral Stricture

Urethral stricture is a condition in which a section of the urethra is narrowed. It can occur congenitally or from a scar along the urethra. Traumatic injury to the urethra (e.g., from instrumentation or infections) can result in strictures that restrict urine flow and decrease the urinary stream, leading to spraying or double stream, postvoiding dribbling, and dilation of the proximal urethra and prostatic ducts. Prostatitis is a common complication. Treatment involves dilation of the urethra or, in severe cases, urethrotomy (surgical removal of the stricture). Antimicrobial agents are necessary for resolution of UTIs, followed by long-term prophylactic therapy until the stricture is corrected. Treatment should not be considered successful until at least 1 year has passed, because strictures may recur anytime during that period (Keane & Graham, 2016).

Circumcision

Circumcision is the surgical excision of the foreskin (prepuce) of the glans penis. According to the CDC, approximately 80% of men are circumcised in the United States, and circumcision is one of the oldest surgical procedures performed worldwide (CDC, 2015). In India, 13.5% of men are circumcised (Morris, Wamai, Henebeng, et al., 2016). There is controversy about the guidelines to determine the validity of male circumcision as a prevention of disease transmission (Earp, 2015). In adults, circumcision may be indicated as part of treatment for phimosis, paraphimosis, and recurrent infections of the glans and foreskin. It also may be performed at the patient's request.

The primary method of circumcision in adults is surgical excision. Postoperatively, a petrolatum (Vaseline) gauze dressing is applied and changed as indicated. The patient is observed for bleeding. Because considerable pain may occur after circumcision, analgesic agents are given as needed.

Abnormal Breast Conditions in Males

Gynecomastia

Gynecomastia is the most common breast condition in the males. Adolescent boys can be affected because of hormones secreted by the testes. This type of gynecomastia is virtually always benign and resolves spontaneously in 1 to 2 years. Gynecomastia can also occur in older men and usually presents as a firm, tender mass underneath the areola. In these patients, gynecomastia may be diffuse and related to the use of certain medications (e.g., digitalis, ranitidine [Zantac]). It may also be associated with certain conditions, including feminizing testicular tumors,

infection in the testes, and liver disease resulting from factors such as alcohol abuse or a parasitic infection.

Patients in their late teens to late 40s presenting with idiopathic (unknown cause) gynecomastia should have a testicular examination and possibly a testicular ultrasound performed. Treatment of the enlarged breast tissue is based on patient preference and is usually reserved for those men who cannot tolerate the cosmetic appearance of the breast or who have severe pain associated with the condition. Mammography and ultrasound are utilized if there is a concern about malignancy. Observation is acceptable in most cases because gynecomastia may resolve on its own. Surgical removal of the tissue through a small incision around the areola is the best treatment option. Liposuction performed by a plastic surgeon is another possibility, although this does not allow for pathologic examination of the tissue

CRITICAL THINKING EXERCISES

1. Identify the priorities, approach, and techniques you would use to perform a health assessment on a 24-year-old male graduate student from a tribal community of North East India who speaks Hindi as a second language and who has been diagnosed with squamous cell carcinoma of the penis. How will your priorities, approach, and techniques integrate cultural considerations into the nursing care?
2. A 65-year-old male patient who has a history of thyroid disease, hypertension, and type II diabetes is diagnosed with prostate cancer with a Gleason score of 4 post biopsy. What evidence-based information would you provide to the patient and his spouse to assist in preventing postoperative complications during the recovery period? Identify the evidence for and the criteria used to evaluate the strength of the evidence for the nursing care identified.
3. You are caring for a 30-year-old man who has been recently advised by his urologist to undergo a circumcision due to repeated episodes of epididymitis. What is the evidence base for his treatment options? Identify the criteria used to evaluate the strength of the evidence. How would you explain the various treatment options to the patient and his significant other?

REFERENCES

*Asterisk indicates nursing research.

Books

American Cancer Society. (2015). Cancer facts and figures 2015. Atlanta, GA: Author.

Centers for Disease Control and Prevention. [CDC]. (2015). National Center for HIV/AIDS, viral hepatitis, STD, and TB prevention: Strategic plan through 2020. Atlanta, GA: Author.

Grossman, S., & Porth, C. M. (2014). Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott, Williams & Wilkins.

Hall, J. E. (2015). Guyton & Hall textbook of medical physiology (13th ed.). Philadelphia, PA: Saunders Elsevier.

Itano, J. K., Brant, J. M., Conde, F. A., et al. (2016). Core curriculum for oncology nursing (5th ed.). St. Louis, MO: Mosby Elsevier.

Karch, A. M. (2016). 2016 Lippincott pocket drug guide for nurses. (4th ed.). Philadelphia, PA: Wolters Kluwer.

Keane, T. E., & Graham, S. D. (Eds.) (2016). Glenn's urologic surgery. Philadelphia, PA: Wolters Kluwer.

McCance, K. L., Huether, S. E., Braskers, V. L., et al. (Eds.). (2013). Pathophysiology: The biologic basis for disease in adults and children (7th ed.). St. Louis, MO: Mosby Elsevier.

McDougal, W. J., Wein, A. J., Kavoussi, L. R., et al. (Eds.). (2016). Campbell-Walsh urology (11th ed.). Philadelphia, PA: Elsevier.

Mulhall, J. P., & Hsiao, W. (Eds.) (2014). Men's sexual health and fertility: A clinician's guide. New York: Springer.

Pagana, K. D., & Pagana, T. J. (2013). Mosby's diagnostic and laboratory test reference (11th ed.). St. Louis, MO: Mosby Elsevier.

Sandhu, J. S. (2015). Urinary dysfunction in prostate cancer. New York: Springer.

Tabloski, P. A. (2014). Gerontological nursing: The essential guide to clinical practice (3rd ed.). New York: Pearson.

Weber, J. R., & Kelley, J. H. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Wincze, J. P., & Weisberg, R. B. (2015). Sexual dysfunction: A guide for assessment and treatment. New York: Guildford Press.

Journals and Electronic Documents

Allkanjari, O., & Vitalone, A. (2015). What do we know about phytotherapy of benign prostatic hyperplasia? Life Sciences, 126(1), 42–56.

Akar, S. Z., & Bebis, H. (2014). Evaluation of the effectiveness of testicular cancer and testicular self-examination training for patient care personnel: Intervention study. Health Education Research, 29(6), 966–976.

Akre, C., Berchtold, A., Gmel, G., et al. (2014). The evolution of sexual dysfunction in young men aged 18–25 years. Journal of Adolescent Health, 55(14), 736–743.

Baker, H. (2014). Choosing a prostate cancer drug. British Journal of Nursing, 23(16), S14–S16.

Barry, M. J., & Hayes, J. H. (2015). Evaluating an elevated screening PSA test. JAMA 314(19), 2073–2074.

*Brand, S., Williams, H., & Braybrooke, J. (2015). How has early testicular cancer affected your life? A study of sexual function in men attending active surveillance for stage one testicular cancer. European Journal of Oncology Nursing, 19(15), 278–281.

Braun, D. P., Gupta, D., Birdsall, T. C., et al. (2013). Effect of naturopathic and nutritional supplement treatment on tumor response, control, and recurrence in patients with prostate cancer treated with radiation therapy. Journal of Alternative & Complementary Medicine, 19(3), 198–203.

Brosman SA. Penile Cancer. https://emedicine.medscape.com/article/446554-overview#a7/ reviewed on 12/04/2018.

Brown, C. S. (2014). Dilutional hyponatremia in a community hospital setting: Case report. Intensive & Critical Care Nursing, 30(1), 1–5.

*Carter, N., Miller, P. A., Murphy, B. R., et al. (2014). Healthcare providers' perspectives of the supportive care needs of men with advanced prostate cancer. Oncology Nursing Forum, 41(4), 421–430.

*Cremin, M. (2015). Meeting the unmet support needs of BME men with prostate cancer. British Journal of Nursing, 24(20), 1010–1014.

Chen, X., Hu, Y., Peng, J., et al. (2015). Association of diet and lifestyle with chronic prostatitis/chronic pelvic pain syndrome and pain severity: A case–control study. Prostate Cancer and Prostatic Disease, 19, 92–99.

Crawford, P. (2014). Evaluation of scrotal masses. American Family Physician, 89(9), 723–727.

Detti, B., Bonomo, P., Masi, L. (2016). CyberKnife stereotactic radiotherapy for isolated recurrence in the prostatic bed. World Journal of Urology, 34(3), 311–317.

Dorey, G. (2013). Pelvic floor exercises after radical prostatectomy. British Journal of Nursing, 22(9), 4–9.

Earp, B. D. (2015). Do the benefits of male circumcision outweigh the risks? A critique of the proposed CDC Guidelines. Frontier Pediatrics, 3(18), 1–3.

Fuller, K. (2014). Diagnosis of testicular cancer. The Journal of Nurse Practitioners, 10(6), 437–438.

Gerend, M. A., Madkins, K., Phillips, G., et al. (2016). Predictors of human papillomavirus vaccination among men who have sex with men. Sexually Transmitted Disease, 43(3), 185–191.

*Gledhill, S. & Schweitzer, R. D. (2013). Sexual desire, erectile dysfunction and the biomedicalization of sex in older heterosexual men. Journal of Advanced Nursing, 70(4), 894–903.

Goodman, A., (2013). Anticoagulant use predicts survival in metastatic prostate cancer. Formulary, 48(5), 1–2.
Hanna, N. H., & Einhorn, L. (2014). Testicular cancer–Discoveries and updates. The New England Journal of Medicine, 371(21), 2005–2016.
Hariharan, K., Padmanabha, V. (2016). Demography and disease characteristics of prostate cancer in India. Indian Journal of Urology, 32(2), 103–108.
Hsu, J. C., Tang, D. H., & Lu, C. Y. (2014). Risk-benefit assessment of oral phosphodiesterase type 5 inhibitors for treatment of erectile dysfunction: A multiple criteria decision analysis. International Journal of Clinical Practice, 69(4), 436–443.
Jain, S., Saxena, S., Kumar. A. (2014). Epidemiology of prostate cancer in India. Meta Gene, 2, 596–605.
Jones, S. (2016). Nurse-led clinic for men receiving targeted therapies for metastatic hormone-relapsed prostate cancer. Cancer Nursing Practice, 15(5), 32–36.
Kelvin, J. F. (2015). Sperm banking: Fertility preservation for male patients with cancer. Clinical Journal of Oncology Nursing, 19(1), 108–110.
Kessler, L. M., Craig, B. M., Plosker, S. M., Reed, D. R., & Quinn, G. P. (2013). Infertility evaluation and treatment among women in the United States. Fertility and sterility, 100(4), 1025–1032. https://doi.org/10.1016/j.fertnstert.2013.05.040
Khoo, V. (2013). Modern management of penile cancer. European Journal of Cancer, Supplement, 11(2), 303–306.
Krieger, J. N., Riley, D. E., Cheah, P. Y., Liong, M. L., Yuen, K. H. (2003). Epidemiology of prostatitis: new evidence for a world-wide problem. World Journal of Urology, 21(2), 70–74.
Kuehn, B. M. (2016). US hospitals prepare for penis transplants. Medical News and Perspectives of the American Medical Association, 315(13), 1322–1324.
Kumar, N., Bhattacharyya, T., Mandal, A. K., et al. (2014). Penile metastasis secondary to bladder cancer: A report of two cases. Indian Journal of Palliative Care, 20(1), 57–60.
Kumar, N., & Singh, A. K. (2015). Trends of male factors infertility an important cause of infertility: A review literature. Journal of Human Reproductive Sciences, 8(4), 191–196.
Kumnig, M., & Jowsey-Gregoire, S. G. (2016). Key psychosocial challenges in vascularized composite allotransplanatation. World Journal of Transplantation, 6(1), 91–102.
Lanier, Y., & Sutton, M. Y. (2013). Reframing the context of preventive health care services and prevention of HIV and other sexually transmitted infections for young men: New opportunities to reduce racial/ethnic sexual health disparities. American Journal of Public Health, 103(2), 262–269.
Lim, P. H. (2013). How incontinence affects sexual health. Australian and New Zealand Continence Journal, 19(4), 117–121.
Lindsey, A. Herrela, M., Goodman, M., et al. (2015). Outcomes of microsurgical vasovasostomy for vasectomy reversal: A meta-analysis and systematic review. Urology, 85(4), 819–825.
Lycken, M., Garmo, H., Adolfsson, J., et al. (2013). Patterns of androgen deprivation therapies among men diagnosed with localized prostatic cancer: A population based study. European Journal of Cancer, 49(9), 1789–1798.
*Martin, F., Turner, A., Bourne, C., et al., (2013). Development and qualitative evaluation of a self-management workshop for testicular cancer survivor-initiated follow-up. Oncology Nursing Forum, 40(1), 14–23.
Mathur, S. K., Gupta, S., Marwah, N., Narula, A., Singh, S., Arora, B. (2003). Significance of mucin stain in differentiating benign and malignant lesions of prostate. Indian Journal of Pathology & Microbiology, 46(4), 593–595.
Mitchell, K. R., Mercer, C. H., Ploubidis, G. B., et al. (2013). Sexual function in Britain: Findings from the Third National Survey of Sexual Attitudes and Lifestyles (Natsal-3). The Lancet, 382, 1817–1829.
Mittal, B. V., Amin, M. B., Kinare, S. G. (1989). Spectrum of histological lesions in 185 consecutive prostatic specimens. Journal of Postgraduate Medicine, 35(3), 157.
Mola, J. R. (2015). Erectile dysfunction in the older adult male. Urologic Nursing, 35(2), 87–93.
Morris, B. J., Wamai, R. G., Henebeng, E. B., Tobian, A. A. R., Klansner, T. D., Banerjee, J., Hankins, C. A. (2016). Estimation of country-specific and global prevalence of male circumcision. Population Health Metrics, 14, 4.
Mulheim, E., Fulbright, N., & Duncan, N. (2015). Prostate cancer screening. American Family Physician, 92(8), 683–688.
National AIDS Control Organization (2017). HIV sentinel surveillance 2016-17; technical brief. Available at: http://naco.gov.in/sites/default/files/HIV%20SENTINEL%20SURVEILLANCE_06_12_2017_0.pdf Retrieved on 07/12/2018.
National Comprehensive Cancer Network. [NCCN]. (2016a). Cancer guidelines. Retrieved on 3/6/2017 at: www.nccn.org/patients/guidelines/cancers.aspx
National Comprehensive Cancer Network [NCCN]. (2016b). Clinical practice guidelines in oncology: Prostate cancer. Retrieved on 3/6/2017 at: www.nccn.org/professionals/default.aspx
National Comprehensive Cancer Network. [NCCN]. (2016c). Clinical practice guidelines in oncology: Testicular cancer. Retrieved on 3/6/2017 at: www.nccn.org/professionals/default.aspx
Norton, W., & Tremayne, P. (2015). Sex and the older man. British Journal of Nursing, 24(4), 218–221.
Owusu-Edusei, K., Gift, T. L., Patton, M. E., et al. (2015). Estimating the total annual cost of providing sexually transmitted infection and HIV testing and counseling for men who have sex with men in the United States. Sexually Transmitted Diseases, 42(10), 586–589.
Pearson, R. (2014). Common questions about the diagnosis and management of benign prostatic hyperplasia. American Family Physician, 90(11), 769–774.
Rathkopf, D., & Scher, H. I. (2013). Androgen receptor antagonists in castration-resistant cancer. The Cancer Journal, 19(1), 43–49.
Report of the MTA of NACP IV [Internet]. 2016 [cited 2018 Mar 7]. Available from: http://www.naco.gov.in/sites/default/files/Report of the MTA of NACP IV - August 2016.pdf
Russell, S. S. (2014). Testicular cancer: Overview and implications for health care providers.\ Urologic Nursing, 34(4), 172–192.
*Saab, M., Noureddine, S., Hujer, H. A., et al. (2014). Surviving testicular cancer: The Lebanese lived experience. Nursing Research, 63(3), 203–209.
Scher, H. I. (2016). Defining new standards of care for men with prostate cancer. The Lancet, 387, 1135–1137.
Schover, L. R., van der Kaaij, M., van Dorst, E., et al. (2014). Sexual dysfunction and infertility as late effects of cancer treatment. European Journal of Cancer Supplement, 12(1), 41–53.
Seid, A., Gerensea, H., Tarko, S., Zenebe, Y., Mezemir, R. (2017). Prevalence and determinants of erectile dysfunction among diabetic patients attending in hospitals of central and northwestern zone of Tigray, northern Ethiopia: a cross-sectional study. BMC Endocrine Disorders, 17(1),16.
Shanmugalingam, T., Soultati, A., Chowdhury, S., Rudman, S., Van Hemelrijck, M. (2013). Global incidence and outcome of testicular cancer. Clinical epidemiology, 5, 417.
Simondsen, K., & Kolesar, J. (2013). New treatment options for castration-resistant prostate cancer. American Journal of Health-System Pharmacy, 70(10), 856–865.
Simpson, P. (2015). Prostatectomy: Information provision and education for patients. British Journal of Nursing, 24(9), 24–28.
Sohn, W., Lee, H. J., & Ahlering, T. E. (2013). Robotic surgery: Review of prostate and bladder cancer. Cancer Journal, 19(2), 133–139.
*Song, L., Rini, C., Deal, A. M., et al. (2015). Improving couples' quality of life through a web-based prostate cancer education intervention. Oncology Nursing Forum, 42(2), 183–192.
Sparling, S. & Cramer, K. (2015). Choosing the danger we think we know: Men's and women's faulty perceptions of sexually transmitted infection risk with familiar and unfamiliar new partners. The Canadian Journal of Human Sexuality, 24(3), 237–242.

Tannenbaum, C. (2015), Associations between urinary symptoms and sexual health in older adults. Clinics in Geriatric Medicine, 31(4), 581–590.
Tantamango-Bartley, Y., Knutsen, S. F., Knutsen, R., et al. (2016). Are strict vegetarians protected against cancer? American Journal of Clinical Nutrition, 103, 153–160.
Tarin, J., Garcia-Perez, M., Hamatani, T., et al. (2015). Infertility etiologies are genetically and clinically linked with other diseases in single meta-diseases. Reproductive Biology and Endocrinology, 13(1), 31–42.
Taylor, S. N. (2015). Epididymitis. Clinical Infectious Diseases, 61(8), 770–773.Thakur, M. K., (2016). Multifaceted and personalized therapy of advanced prostate cancer. Current Opinion in Oncology, 28(3), 222–231.
Thangadurai, P., Gopalakrishnan, R., Abraham, V. J, Prasad J, Kuruvilla, A., Jacob, K. S.(2014). Sexual dysfunction among men in secondary care in southern India: Nature, prevalence, clinical features and explanatory models;27(4),198–201.
Tsai, M., Liu, C., Chang, C., et al. (2014). Overview of the relevant literature on the possible role of acupuncture in treating male sexual dysfunction. Acupuncture Medicine, 32, 406–410.
Turner, B., Drudge-Coates, L., & Henderson, S. (2013). Penile cancer: Diagnosis, clinical features and management. Nursing Standard, 27(29), 50–57.
Wagenlehner, F. M. E.; Weidner, W., Pilatz, A., et al. (2014). Urinary tract infections and bacterial prostatitis in men. Current Opinion in Infectious Diseases, 27(1), 97–101.
WHO. | Global incidence and prevalence of selected curable sexually transmitted infections – 2008 [Internet]. [cited 2018 Mar 7]. Available from: http://www.who.int/reproductivehealth/publications/rtis/stisestimates/en/
Xu, X.-F., Liu, G.-X., Guo, Y.-S., et al. (2021). Global, regional, and national incidence and year lived with disability for benign prostatic hyperplasia from 1990 to 2019. American Journal of Men's Health. https://doi.org/10.1177/15579883211036786.

Resources

American Cancer Society, www.cancer.org/cancer/prostatecancer/
American Urological Association, www.auanet.org
CancerCare, www.cancercare.org
Centers for Disease Control and Prevention (CDC), www.cdc.gov/cancer
Hartford Institute for Geriatric Nursing, Consult Geri website, www.consultgerirn.org/topics/urinary_incontinence/want_to_know_more
Indian Prostate Cancer Foundation (IPCF), http://www.indianprostatecancerfoundation.com
National Institutes of Health, National Center for Complementary and Integrative Health (NCCIH), nccih.nih.gov
National Cancer Institute (NCI), www.cancer.gov
National Comprehensive Cancer Network (NCCN), www.nccn.org
Prostate Cancer Foundation, www.pcf.org
Testicular Cancer Society (TCS), www.testicularcancersociety.org
Urology Care Foundation, www.urologyhealth.org
Us TOO International Prostate Cancer Education and Support Network, www.ustoo.org

UNIT

XV

Burns, Reconstruction, and Cosmetic Surgery

Chapter 47 Assessment and Management of Burn Injury, Reconstruction, and Cosmetic Surgery 1509

CHAPTER 47

Assessment and Management of Burn Injury, Reconstruction, and Cosmetic Surgery

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Explain the factors that affect the severity of burn injury.
2. Describe the local and systemic effects of a major burn injury.
3. Compare priorities of care and potential complications for each phase of burn recovery.
4. Plan fluid replacement requirements during the emergent/resuscitative phase of a burn injury.
5. Discuss the nurse's role in burn wound management during the acute/intermediate phase of burn care.
6. Use the nursing process as a framework of care for the patient with burns.
7. Recognize the psychosocial challenges associated with burn injuries and identify strategies for intervention.
8. Identify the management and nursing care of patients undergoing plastic and cosmetic procedures.

GLOSSARY

autograft: a graft derived from one part of a patient's body and used on another part of that same patient's body
carboxyhemoglobin: a compound of carbon monoxide and hemoglobin, formed in the blood with exposure to carbon monoxide
collagen: a protein present in skin, tendon, bone, cartilage, and connective tissue
contracture: shrinkage of burn scar through collagen maturation
débridement: removal of foreign material and devitalized tissue until surrounding healthy tissue is exposed
derma filler: substances used to augment soft tissues to replace the lost subcutaneous fat
donor site: the area from which skin is taken to provide a skin graft for another part of the body
eschar: devitalized tissue resulting from a burn or wound
escharotomy: a linear excision made through eschar to release constriction of underlying tissue
excision: surgical removal of tissue
fasciotomy: an incision made through the fascia to release constriction of underlying muscle
gender reassignment: a gender affirmation surgery that involves genital reconstruction to change the genitalia from one gender to another
homograft: a graft transferred from one human (living or cadaveric) to another human; also called *allograft*
liposuction: a surgical intervention in which excess subcutaneous fat is removed using special cannula to achieve aesthetic body contour
skin rejuvenation: measures to bring back the lost contour and glow
xenograft: a graft obtained from an animal of a species other than that of the recipient (e.g., pigskin); also called *heterograft*

Introduction

Burn injuries are painful, costly, disfiguring, require intensive and extensive rehabilitation therapy, and are often associated with long-term disability. Advances in burn care that include optimal fluid resuscitation, infection control, early excision and grafting, an enhanced team approach, and the emergence of specialized burn centers have contributed to significant improvements in morbidity and mortality of patients with burns (Meyerson, Coffey, Jones, et al. 2015); (Sen, Palmieri, & Greenhalgh, 2015). The role of the nurse in the interdisciplinary treatment team includes provision of holistic evidence-based care during all phases of burn injury recovery to optimize patient outcomes.

Overview of Burn Injury

Incidence

A burn injury can affect people of all ages and socioeconomic groups. It is estimated that 300,000 deaths occur all over the globe due to burns. Out of this >95% deaths occur in middle and low income countries of the South East Asia Region. In India, 7 million people sustain burn injuries every year. Out of this, 0.14 million people die and 2.4 lakh people become crippled. A higher proportion of females die than males (Bhansali, Gandhi, Sahastrabudhe et al., 2017).

A long-term study done in a tertiary care center showed that 95% of burns were due to thermal and scalds injury. 3.8% sustained electrical burns and only 0.2% suffered chemical burns. Out of the 3179 patients admitted with burns, 54.51% of them died. Death among female patients was 40% more than that of males. Mortality rate was higher with older people. The study revealed that the survival rate is dependent on the percentage of BSA. The survival rate for patients with 30–52% BSA was 44% whereas for patients with BSA above 52–80%, survival rate reduced to mere 3% (Bhansali, et al., 2017).

Patients with burns have particularly prolonged hospital lengths of stay (LOS). Many patients require multiple surgical interventions, extensive pain control, immobilization and rehabilitation, and prolonged intravenous (IV) medication regimens, particularly with antibiotics and opioids.

Gerontologic Considerations

The skin of the older adult is thinner and less elastic, which affects the depth of injury and its ability to heal. Delayed wound healing, another consequence of aging, is associated with higher morbidity and mortality (Nitzschke, Aden, Serio-Melvin, et al., 2014). Pulmonary function becomes impaired with age; therefore, airway exchange, lung elasticity, and ventilation may be altered and can be exacerbated by a history

of smoking. Decreased cardiac output, coronary artery disease, and decreased cardiovascular compensatory response may increase the risk of complications in older adult patients with burn injuries. There may be a fine line between adequate fluid resuscitation and fluid overload in this population. Decreased kidney and hepatic function can impact medication dosing due to altered medication clearance. Malnutrition may impact morbidity and mortality in older adults, especially those who are institutionalized. Additionally, older patients may have varying degrees of mental capacity on admission or through the course of care, making assessment of pain, anxiety, and delirium a challenge for the burn team.

A recent retrospective review of 1461 patients with burns admitted to a burn center between 2006 and 2015 revealed the Lethal Dose 50 (LD50) (i.e., lethal burn dose) for patients over 65 years of age is 35% of the TBSA, unchanged in the last 30 years, despite advances in burn care. Although there was no significant difference in incidence of pneumonia, bacteremia, sepsis, wound infection, kidney injury, abdominal compartment syndrome (ACS), acute respiratory distress syndrome (ARDS), or deep vein thrombosis (DVT), there was a statistical increase in LOS, gastrointestinal (GI) bleeding, and mortality when compared to patients less than 65 years of age. Furthermore older adult patients displayed impaired capacity for wound healing, impaired immune response, increased risk for multiple organ failure, an inability to respond to stressors, and profound alterations in metabolism (Jeschke, Patsouris, Stanojcic, et al., 2015).

Comorbidities and the resultant treatment polypharmacy (i.e., multiple medication prescriptions) contribute to in-hospital complications as well as increase the need for discharge to a facility other than the patient's home after acute recovery (Justiniano, Coffey, Evans, et al., 2015). Nurses need to assess an older adult patient's ability to safely perform activities of daily living (ADLs), assist older adult patients and families to modify their environment to ensure safety, and make referrals as needed.

Prevention

Burns are preventable. An important goal of nurses in community and home settings is to provide education about the prevention of burn injury (see Chart 47-1). Nurses should capitalize on the teachable moment, an opportunity using a recent injury event, as a prime time people "are likely to be more receptive to accept guidance on how to change their behavior to avoid future injury" (Klas, Smith, Matherly, et al., 2015, p. 434). High-risk behaviors such as alcohol consumption and alcohol abuse often precipitate many burn injuries (Sen et al., 2015). The World Health Organization (WHO) recommends heightened awareness of the burden of burn injury and risk factors as imperatives to develop an effective burn prevention program (WHO, 2014).

Outlook for Survival and Recovery

WHO (2014) estimated 265,000 annual deaths worldwide are caused by burns, the majority occurring in middle- to low-income populations, while nonfatal burns are a leading cause of morbidity including disfigurement, disability, and social stigma. The strongest predictors for mortality in burn injuries included increased percent of TBSA burned, presence of inhalation injury, and increased age. Provision of evidenced-based, multidisciplinary, holistic care is crucial to improving both survival and recovery, culminating in re-integration of the survivor into society.

Chart 47-1 HEALTH PROMOTION

Burn Prevention

- Advise that matches and lighters be kept out of the reach of children.
- Emphasize the importance of never leaving children unattended around fire or in bathroom/bathtub.
- Educate about the installation and maintenance of smoke and carbon monoxide detectors on every level of the home and changing batteries annually on birthday.
- Recommend the development and practice of a home exit fire drill with all members of the household.
- Advocate setting the water heater temperature no higher than 48.9°C (120°F).
- Educate about the perils of smoking in bed, smoking while using home oxygen, or falling asleep while smoking.
- Caution against using flammable liquids to start fires and/or throwing flammable liquids onto an already burning fire.
- Warn of the danger of removing the radiator cap from a hot car engine.
- Recommend avoidance of overhead electrical wires and underground wires when working outside.
- Advise that hot irons and curling irons be kept out of the reach of children.
- Discourage running electric cords under carpets or rugs.
- Recommend storage of flammable liquids well away from a fire source, such as a pilot light.
- Educate about the importance of being aware of loose clothing when cooking over a stovetop or flame.
- Recommend having a working fire extinguisher in the home and knowing how to use it.

Great strides in research on treatment have helped to increase the survival rate of patients with burn injuries. Long-term outcomes can now be evaluated because patients with very large burns are surviving their injuries. Improvements in fluid resuscitation, infection control, nutrition delivery, early burn excision (i.e., surgical removal of tissue), wound closure, modulation of the metabolic response, and development of burn centers have contributed to the survivability and recovery from burn injuries (Rousseau, Massion, Laungani, et al., 2014); (Snell, Loh, Mahambrey, et al., 2013). Continued research and advances in the areas of critical care, rehabilitation, and psychosocial and scar management are essential for continued progress in burn care.

Severity

The severity of each burn injury is determined by multiple factors. These factors include age of the patient; depth of the burn; amount of surface area of the body that is burned; the presence of inhalation injury; presence of other injuries; location of the injury in areas such as the face, the perineum, hands, or feet; and the presence of comorbid conditions. Even in specialized burn centers, adults with more than 40% TBSA burned are at high risk for mortality and morbidity (Jeschke et al., 2015). Careful assessment enables the burn team to estimate the likelihood of survival and develop an individualized plan of care for each patient.

Age

Young children and older adults continue to have increased morbidity and mortality when compared to other age groups with similar injuries and present a challenge for the burn team. Thinner skin at both ends of the age spectrum leads to deeper

burns with more complications. This is an important factor when determining the severity of injury and possible outcome for the patient.

Burn Depth

Burns are classified according to the depth of tissue destruction as depicted in Table 47-1. First-degree burns are superficial injuries that involve only the outermost layer of skin. These burns are erythematous, but the epidermis is intact; if rubbed, the burned tissue does not separate from the underlying dermis. This is known as a negative Nikolsky's sign. A typical first-degree burn is a sunburn or superficial scald.

Second-degree burns involve the entire epidermis and varying portions of the dermis. They are painful and are typically associated with blister formation. Healing time depends on the depth of dermal injury and typically ranges from 2 to 3 weeks. Hair follicles and skin appendages remain intact.

Third-degree (full-thickness) burns involve total destruction of the epidermis, dermis, and, in some cases, damage of underlying tissue. Wound color ranges widely from pale white to red, brown, or charred. The burned area lacks sensation because nerve fibers are damaged. The wound appears leathery and dry due to the destruction of the microcirculation; hair follicles and sweat glands are destroyed. The severity of this burn is often deceiving to patients because they have no pain in the injury area (see Fig. 47-1).

Fourth-degree burns (deep burn necrosis) are those injuries that extend into deep tissue, muscle, or bone (see Fig. 47-2) (Kearns, Cairns, Holmes, et al., 2013).



Figure 47-1 • Third-degree (full-thickness) burn to arm and upper back with surrounding second-degree (partial-thickness) burn. Used with permission from University of Texas Medical Branch, Galveston, TX.

Burn depth determines whether spontaneous re-epithelialization will occur. Determining burn depth can be difficult even for the experienced burn care provider. The following factors are considered in determining the depth of a burn: how the injury occurred, causative agent (such as flame or scalding liquid), temperature and duration of contact with the causative agent, and thickness of the skin at the injury site.

TABLE 47-1 Characteristics of Burns According to Depth

Causes	Skin Involvement	Clinical Manifestations	Wound Appearance	Recuperative Course and Treatment
First Degree (Superficial)				
Sunburn Low-intensity flash Superficial scald	Epidermis	Tingling Hyperesthesia (hypersensitivity) Pain that is soothed by cooling Peeling Itching	Reddened; blanches with pressure; dry Minimal or no edema Possible blisters	Complete recovery within a few days Oral pain medications, cool compresses, skin lubricants (e.g., ointments, emollients); topical antimicrobial agents not indicated
Second Degree (Partial Thickness)				
Scalds Flash flame Contact	Epidermis, portion of dermis	Pain Hyperesthesia Sensitive to air currents	Blistered, mottled red base; disrupted epidermis; weeping surface Edema	Recovery in 2–3 weeks Some scarring and depigmentation possible; may require grafting
Third Degree (Full Thickness)				
Flame Prolonged exposure to hot liquids, Electric current or Chemical Contact	Epidermis, dermis, and sometimes subcutaneous tissue; may involve connective tissue, and muscle	Insensate Shock Myoglobinuria (red pigment in urine) and possible hemolysis (blood cell destruction) Possible contact points (entrance or exit wounds in electrical burns)	Dry; pale white, red brown, leathery, or charred Coagulated vessels may be visible. Edema	Eschar may slough Grafting necessary Scarring and loss of contour and function
Fourth Degree (Full Thickness That Includes Fat, Fascia, Muscle, and/or Bone)				
Prolonged exposure or high voltage electrical injury	Deep tissue, muscle and bone	Shock Myoglobinuria (red pigment in urine) and possible hemolysis (blood cell destruction)	Charred	Amputations likely Grafting of no benefit, given depth and severity of wound(s)

Adapted from American Burn Association. (2011). Advanced burn life support (ABLS) course provider manual 2011. Chicago, IL: Author; Kearns, R. D., Cairns, C. B., Holmes, J. H., et al. (2013). Thermal burns: A review of best practice. EMS World, 42(1), 43–51.



Figure 47-2 • Fourth-degree burn to second digit. Used with permission from University of Texas Medical Branch, Galveston, TX.

Extent of Body Surface Area Injured

Various methods are used to estimate the TBSA affected by burns; among them are the rule of nines, the Lund and Browder method, and the palmer method. These tools assist the treatment team in making decisions about the plan of care, which may include transfer of the patient to a burn center. Burn centers are hospital based and are specially equipped with the resources and personnel to treat patients with burns from the time of injury through their rehabilitation. Burn center designation is jointly conferred by the ABA and the American College of Surgeons (ABA, 2014). Chart 47-2 provides the criteria for referral to a burn center.

Rule of Nines

The most common method used to estimate the extent of burns in adults is the rule of nines (see Fig. 47-3). This system is based on anatomic regions, each representing approximately 9% of the TBSA, allowing clinicians to quickly obtain an estimate of burn size. If a portion of an anatomic area is burned, the TBSA is calculated accordingly—for example, if approximately half of one arm were burned, the TBSA burned would be 4.5% (Kearns et al., 2013).

Chart 47-2

American Burn Association Criteria for Referral to a Burn Center

- Partial-thickness burns covering 10% of total body surface area or greater
- Burns involving the face, hands, feet, genitalia, perineum, or major joints
- Third-degree burns
- Electrical burns, including lightning injury
- Chemical burns
- Inhalation injury
- Burn injury in patients with preexisting medical disorders
- Any patients with burns and concomitant trauma
- Children with burn injuries in facilities that do not specialize in pediatric care
- Patients who will require special social, emotional, or long-term rehabilitation

Adapted from American Burn Association. (2011). Advanced burn life support (ABLS) course provider manual 2011. Chicago, IL: Author.

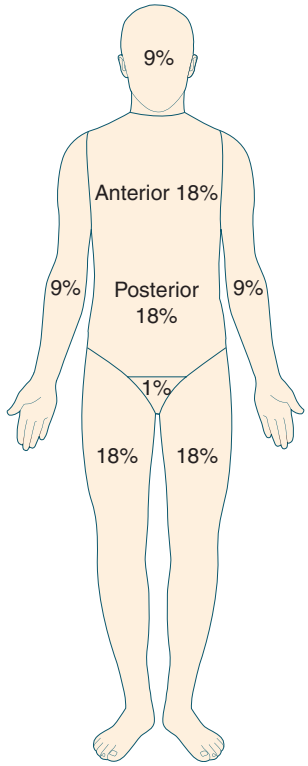


Figure 47-3 • The rule of nines. Estimated percentage of total body surface area (TBSA) in the adult is calculated by sectioning the body surface into areas with a numerical value related to nine. (*Note*: The anterior and posterior head total 9% of TBSA.)

Lund and Browder Method

A more precise method of estimating the extent of a burn is the Lund and Browder method (Kearns et al., 2013), which recognizes the percentage of surface area of various anatomic parts, especially the head and legs, as it relates to the age of the patient. By dividing the body into very small areas and providing an estimate of the proportion of TBSA accounted for by each body part, clinicians can obtain a reliable estimate of TBSA burned. The initial evaluation is made on arrival of the patient to the hospital and should be revised within the first 72 hours, because demarcation of the wound and its depth present themselves more clearly by this time. The Lund and Browder chart is readily available in both printed and electronic formats.

Palmer Method

In patients with scattered burns, the Palmer method may be used to estimate the extent of the burns. The size of the patient's hand, including the fingers, is approximately 1% of that patient's TBSA (ABA, 2011).

Pathophysiology

Burn injuries are very traumatic injuries as the initial injury can evolve and worsen over time. Burn injury is the result of a chemical injury or heat transfer from one site to another, causing tissue destruction through coagulation, protein denaturation, or ionization of cellular contents. The burn wound is not homogenous; rather, tissue necrosis occurs at the center of the

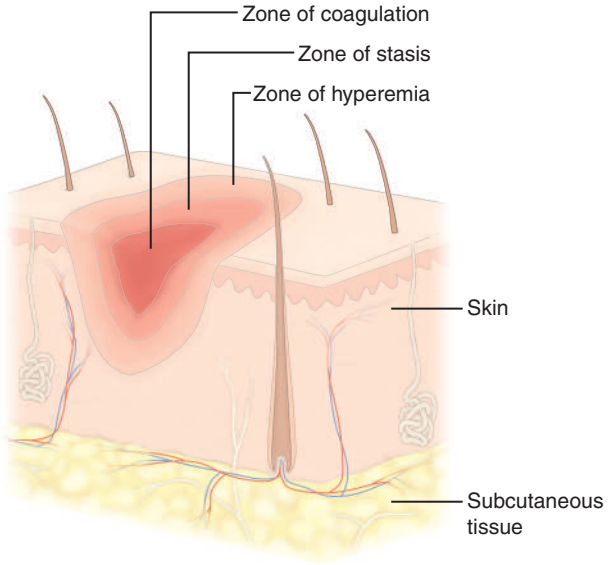


Figure 47-4 • Zones of burn injury. Each burned area has three zones of injury. The zone of coagulation (the innermost area, where cellular death occurs) sustains the most damage. The zone of stasis (the middle area) has a compromised blood supply, inflammation, and tissue injury. The zone of hyperemia (the outermost area) sustains the least damage.

injury with regions of tissue viability toward the periphery. The central area of the wound is termed the *zone of coagulation* due to the characteristic coagulation necrosis of cells that occurs (see Fig. 47-4). The surrounding zone, the *zone of stasis,* describes an area of injured cells that may remain viable but, with persistent ischemia, will undergo necrosis within 24 to 48 hours. The outermost zone, the *zone of hyperemia,* sustains minimal injury and may fully recover spontaneously over time.

The skin and the mucosa of the upper airways are the most common sites of tissue destruction, although deep tissues, including the viscera, can be damaged by electrical burns (see Chart 47-3) or by prolonged contact with a heat or chemical source. The release of local mediators and changes in blood flow, tissue edema, and infection can cause progression of the burn injury.

Another potential mechanism of burn injury is radiation exposure. This has received increased attention because of threats of terrorism and recent world events. Radiation injuries produce two detrimental effects. The first is a thermal effect, which results in cutaneous burn injuries. The second effect is damage to the cellular deoxyribonucleic acid (DNA), which may be localized or affect the whole body. Morbidity and mortality are dose dependent (see Chapter 61). Treatment for the cutaneous injury is the same as other burns discussed in this chapter.

The depth of a burn injury depends on the temperature of the burning agent and the duration of contact with the agent. In adults, exposure to temperatures of 54°C (130°F) for 30 seconds will result in burn injury. At 60°C (140°F), tissue destruction occurs in 5 seconds (this is a common setting for home water heaters; see Chart 47-1 for discussion of appropriate water heater setting). At 71°C (160°F) or higher, a full-thickness burn occurs instantaneously (ABA, 2011).

Major burn injuries, those that affect more than 30% TBSA, produce both local and systemic effects characterized by burn wound edema, generalized edema formation in noninjured tissue, increased metabolic rate (hypermetabolism), hyperdynamic circulation, increased oxygen and glucose consumption, catabolism of muscle and bone, immune dysfunction, insulin resistance, and impaired organ perfusion (Flores, Stockton, Roberts, et al., 2015); (Snell et al., 2013). Severe injuries ultimately encompass changes in pathophysiology of all body systems as presented in Table 47-2 and Figure 47-5. Initially, these responses are compensatory adaptive responses to the burn injury, but quickly become counterproductive events negatively impacting recovery (Abdullahi & Jeschke, 2014). These pathologic responses are also seen in trauma, but the magnitude, duration, and severity are significantly higher with burn injuries.

TABLE 47-2 Pathophysiologic Changes with Severe Burns

Body System	Physiologic Changes
Cardiovascular	Cardiac depression, edema, hypovolemia
Pulmonary	Vasoconstriction, edema
Gastrointestinal	Impaired motility and absorption, vasoconstriction, loss of mucosal barrier function with bacterial translocation, increased pH
Kidney	Vasoconstriction
Other	Altered thermoregulation, immunodepression, hypermetabolism

Adapted from Abdullahi, A., & Jeschke, M. G. (2014). Nutrition and anabolic pharmacotherapies in the care of burn patients. Nutrition in Clinical Practice, 29(5), 621–630; Snell, J. A., Loh N. W., Mahambrey, T, et al. (2013). Clinical review: The critical care management of the burn patient. Critical Care, 17(5), 241.

Cardiovascular Alterations

When a burn injury occurs, there is an immediate decrease in cardiac output that precedes the loss of plasma volume, although the exact mechanism why this occurs is unknown. Due to vasoconstrictive compensatory responses secondary to plasma volume loss, the workload of the heart and oxygen demand increase.

Hypovolemia is the immediate consequence of ensuing plasma volume loss and results in decreased perfusion and oxygen delivery. As fluid loss continues due to capillary leakage, and vascular volume decreases, cardiac output continues to decrease and the blood pressure drops. This is the onset of burn shock. Burn shock is initially a type of hypovolemic shock. The systemic inflammation causes the release of free oxygen radicals that increase capillary permeability, causing increased plasma loss and subsequent peripheral edema. As a compensatory response to intravascular fluid loss, the sympathetic nervous system releases catecholamines, resulting in an increase in peripheral resistance (vasoconstriction) and an increase in pulse rate that further decreases tissue perfusion.

Prompt, appropriate fluid resuscitation maintains the blood pressure in the low to normal range and improves cardiac output (see later discussion). But, despite adequate fluid resuscitation, cardiac filling pressures (central venous pressure, pulmonary artery pressure, and pulmonary artery wedge pressure) remain low during the initial burn shock period. Unlike traumatic injuries, which are often characterized by blood loss, only plasma is lost in the burn injury. If adequate IV fluids are not given to maintain vascular volume, distributive shock occurs (see Chapter 8).

Generally, the greatest volume of fluid leak occurs in the first 24 to 36 hours after the burn, peaking by 6 to 8 hours. As the capillaries begin to regain their integrity, burn shock resolves and fluid returns to the vascular compartment. Intrinsic

Chart 47-3

Electrical Burns

Electrical injuries are devastating and complex burns. Heat generated by electricity is directly responsible for tissue damage, but unlike most thermal burns, visual examination is not predictive of burn size and severity. It is helpful to know the circumstances of the injury to anticipate potential tissue damage and complications. Superficial injuries present themselves as contact points on physical examination. Deep tissue injuries may not be visible on initial clinical presentation but in most circumstances should be assumed on presentation so that timely intervention may be initiated. Mechanisms of injury include flash, conductive, and lightning injury.

Flash Injury

An electrical flash generates light and heat. Injury is caused by the heat generated to exposed areas, or by flames from ignition of clothing. Flash burns are thermal burns and have fewer complications; patients with flash injuries have shorter lengths of hospital stay than those with conductive injuries.

Conductive Injury

Conductive electrical injuries occur when the current overcomes the skin's resistance and travels through the body. The amount and severity of tissue damage is directly proportional to the strength of the current (voltage), duration of contact with the source, which organs lay along the pathway of current, and whether the current is direct or alternating. Conduction of electricity through the nerves and vessels and along the outside of bones generates heat, causing damage to adjacent tissues and direct injury to the peripheral nerves. Deep muscle injury may be present without injury to superficial muscles, masking the true extent of the injury. In addition, electrical current immediately contracts muscles as it travels through the body causing possible skeletal and joint injuries in high-voltage contact. Although the majority of reported electrical injuries are high voltage (>1000 volts) injuries, significant physical and psychological morbidity also occur with low voltage (<1000 volts) injuries as well.

Entrance and exit wounds or contact points can help identify the probable current path and therefore anticipated tissue and organ involvement. Direct current (DC) travels in one direction, is associated with an explosion and likely concomitant trauma from the blast. Alternating current (AC) passes back and forth from the point of contact, through the body and back to the source many times per second and can hold the victim to it, increasing contact time. Compartment syndrome is common with electrical injuries due to the edema that results from injured tissue compounded by the large fluid volumes required for resuscitation to prevent kidney failure. As a result, invasive decompressive therapies such as fasciotomies, nerve releases, ocular releases, and laparotomies may be required.

Lightning Injury

Lightning injuries can result from a direct strike, a high-voltage DC injury that is usually fatal, or a side flash wherein the current discharges from an object nearby through the air to an adjacent object or person. Side flashes are the most common cause of injury and result in immediate deep polarization of the entire myocardium with possible cardiac arrest. Respiratory arrest is also expected because electric current can temporarily inactivate the brain's respiratory center. People struck by lightning may suffer from various debilitating long-term symptoms including memory loss, attention deficits, sleep disorders, chronic pain, numbness, dizziness, stiffness in joints, irritability, fatigue, weakness, muscle spasms, and depression.

Management

Resuscitation fluid calculations based on total body surface area are inaccurate in conductive electrical injuries, including some lightning injuries. It is difficult to quantify the extent of tissue injury without surgical exploration because the damage may not be visible on physical examination. Serum creatinine kinase levels are useful in determining the degree of muscle injury in the early phases of care. Myoglobinuria, common with muscle damage, may cause kidney failure if not treated. IV fluid administration titrated to a higher target of urine output per hour than usual may be indicated until the urine is no longer red. It is common practice to add 50 mEq of sodium bicarbonate per liter of IV fluid in an effort to assist in alkalinizing the urine. Serum myoglobin and urine myoglobin levels may be monitored as indicators of the need for continued resuscitation.

Finally, the surgical treatment of an electrical injury is as complex as the injury itself. Vasculature is commonly affected; thus, progressive tissue necrosis occurs over time. Sequential surgical débridement may be necessary, using caution to preserve viable tissue.

Adapted from Cahill, K. C., Tiong, W. H. C. & Conroy, F. J. (2013). Trineural injury to the right hand after domestic electrocution. Journal of Burn Care and Research, 35(5), e353–e356; Kwon, K. H., Kim, S. H., & Minn Y. K. (2014). Electrodiagnostic study of peripheral nerves in high-voltage electrical injury. Journal of Burn Care and Research, 35, e230–233; National Oceanic and Atmospheric Administration. (2015). Lightning safety. Retrieved on 6/10/2016 at: www.lightningsafety.noaa.gov/index.shtml; Russell, K. W., Cochran, A. L., Mehta, S. T., et al. (2013). Lightning burns. Journal of Burn Care and Research, 35(6), e436–e438; Stergiou-Kita, M., Mansfield, E., Bayley, M., et al. (2014). Returning to work after electrical injuries: Workers' perspectives and advice to others. Journal of Burn Care and Research, 35(6), 498–507.

diuresis will begin and continue for several days to 2 weeks in the previously healthy adult.

Fluid and Electrolyte Alterations

Edema forms rapidly after a burn injury. A superficial burn will cause edema to form within 4 hours, whereas a deeper burn will continue to form edema up to 18 hours post-injury. This is caused by increased perfusion to the injured area in the presence of increased capillary permeability and reflects the amount of microvascular and lymphatic damage to the tissue. In burns greater than 30% TBSA, inflammatory mediators stimulate local and systemic reactions resulting in extensive shift of intravascular fluid, electrolytes, and proteins into the surrounding interstitium (Snell et al., 2013).

Nursing Alert: For patients in the emergent/resuscitative phase, nurses should do a primary survey and monitor circulation. As the taut, burned tissue becomes unyielding to the edema underneath its surface, it begins to act like a tourniquet, especially if the burn is circumferential. As edema increases, pressure on small blood vessels in the distal extremities causes an obstruction of blood flow and consequent tissue ischemia and compartment syndrome. See Chapter 38 for discussion of compartment syndrome. Patients in the acute/intermediate phase must be monitored for the development of venous thromboembolism (VTE).

Treatments for edema may include elevation of the extremity or, in severe cases, removal of eschar (i.e., devitalized tissue) via escharotomy (i.e., surgical incision through eschar), or

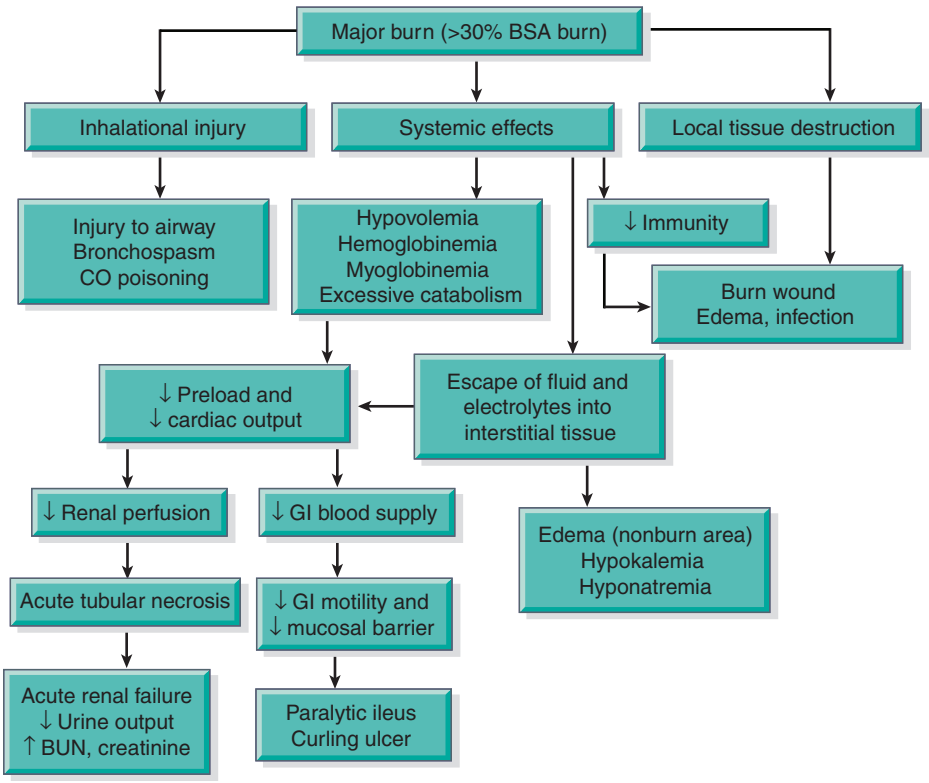


Figure 47-5 • Pathophysiology of major burn injury.

decompression of edema formation via fasciotomy (i.e., surgical incision through fascia to relieve constricted muscle) to restore tissue perfusion (see Figs. 47-6 and 47-7).

Reabsorption of edema begins at about 4 hours post-injury and is complete by 4 days post-burn injury. However, the rate of reabsorption depends on the depth of injury to the tissue. Although adequate fluid resuscitation is paramount to maintaining tissue perfusion, excessive fluid administration increases edema formation in both burned and nonburned tissue causing ischemia and necrosis.

Immediately after burn injury, hyperkalemia (excessive potassium) may result from massive cell destruction. Hypokalemia (potassium depletion) may occur later with fluid shifts and inadequate potassium replacement. Serum sodium levels vary in response to fluid resuscitation. Hyponatremia (serum sodium depletion) may be present as a result of plasma loss or may also occur during the first week of the acute phase, as water shifts from the interstitial space and returns to the vascular space.

At the time of burn injury, some red blood cells may be destroyed and others damaged, resulting in anemia. Despite



Figure 47-6 • Escharotomy of forearm. Used with permission from University of Texas Medical Branch, Galveston, TX.

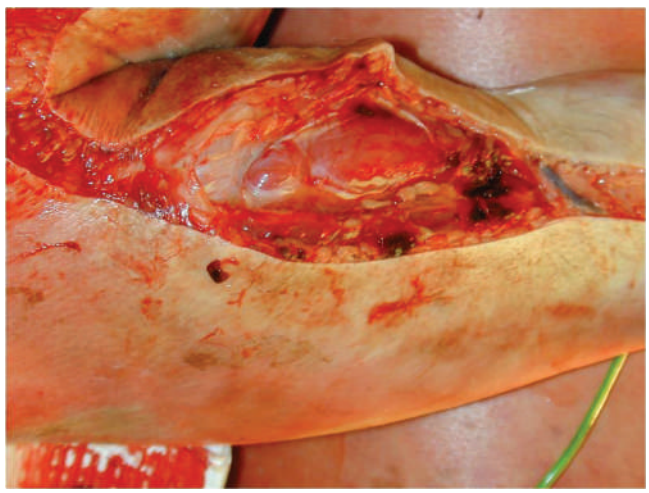


Figure 47-7 • Fasciotomy of upper arm. Used with permission from University of Texas Medical Branch, Galveston, TX.

this, the hematocrit may be elevated due to plasma loss. Abnormalities in coagulation, including a decrease in platelets (thrombocytopenia) and prolonged clotting and prothrombin times, also occur.

Pulmonary Alterations

Inhalation injury is caused by inhalation of thermal and/or chemical irritants. Inhalation injuries are categorized as upper airway injury (above the glottis) or lower airway injury (below the glottis). Injuries above the vocal cords can be thermal or chemical, whereas injuries below the vocal cords are usually chemical (ABA, 2011). Approximately 6% to 30% of patients admitted to burn centers have an inhalation injury (ABA, 2011). The presence of inhalation injury is important to recognize. History of the injury, such as a flame injury occurring in an enclosed space, and clinical signs such as singed facial hair or carbonaceous sputum should be considered indicators for the presence of a smoke inhalation injury. Bronchoscopy is considered the standard test for definitive diagnosis as initial chest x-rays appear normal. The extent of damage is directly related to the temperature and the concentration of toxic gases.

Upper Airway Injury

Upper airway injury is obstructive and is caused by severe upper airway edema from direct thermal injury or secondary edema from face or neck burns in the early post-burn period. Because of the cooling effect of rapid vaporization in the oropharynx, direct heat injury does not normally occur below the level of the glottis. However, with steam exposure, thermal injury to the lower airways is possible because the upper airway cannot effectively protect the lower airway from steam.

Lower Airway Injury

Inhalation injury below the glottis results from inhaling the products of incomplete combustion or noxious gases and is often the source of death at the scene of a fire. Smoke inhalation injuries cause loss of ciliary action, trigger an inflammatory response causing hypersecretion, and produce severe mucosal edema and possibly bronchospasm. Alveolar surfactant production is reduced, resulting in atelectasis (collapse of alveoli). Expectoration of carbon particles in the sputum is the cardinal sign of this injury.

Noxious gases, such as carbon monoxide and hydrogen cyanide, contribute to lower airway injuries. Carbon monoxide poisoning is a factor in most fatalities at the scene of a fire as it combines with hemoglobin and displaces oxygen to form carboxyhemoglobin. The affinity of hemoglobin for carbon monoxide is 200 times greater than that for oxygen, and if significant quantities of carbon monoxide are present, then tissue hypoxia will occur (ABA, 2011). Treatment is administration of 100% oxygen to displace the carbon monoxide molecules bound to hemoglobin. Hydrogen cyanide is a systemic toxin also associated with mortality. Signs and symptoms of hypoxia in light of normal arterial oxygen tension (PaO_2) is an indicator of cyanide poisoning (Snell et al., 2013).

Bronchoconstriction (caused by release of histamine, serotonin, and thromboxane [a powerful vasoconstrictor]) and chest constriction secondary to circumferential torso burns can contribute to deterioration. Even without pulmonary injury, hypoxia may be present. Early in the post-burn period, catecholamine release in response to the stress of the burn injury alters peripheral blood flow, thereby reducing oxygen delivery to the periphery. Later, hypermetabolism and continued catecholamine release lead to increased tissue oxygen consumption, which can also lead to hypoxia. To ensure that adequate oxygen is available to the tissues, supplemental oxygen may be needed. Restrictive pulmonary excursion may occur with full-thickness burns encircling the thorax resulting in decreased tidal volume. In such situations, an escharotomy may be necessary to restore adequate chest excursion.

Kidney Alterations

Kidney function may be altered as a result of decreased blood volume post-burn injury due to the compensatory response to intravascular volume loss. Adequate fluid volume replacement can restore renal blood flow, increasing the glomerular filtration rate and urine volume. Additionally, destruction of red blood cells at the injury site results in free hemoglobin in the urine. If muscle damage occurs (e.g., from electrical burns), myoglobin is released from the muscle cells and excreted by the kidneys causing the urine to be red. If there is inadequate blood flow through the kidneys caused by the hemoglobin and myoglobin occluding the renal tubules, acute tubular necrosis and acute kidney injury will occur (see Chapter 44). Increased abdominal pressure from the injury can also cause kidney ischemia.

Immunologic Alterations

The immunologic defenses of the body are greatly altered by a burn injury. The skin is the largest barrier to infection, and when it is compromised, the patient is continually exposed to the environment. The burn injury itself produces systemic release of cytokines and other substances that cause leukocyte and endothelial cell dysfunction. Burn centers provide an infection-controlled environment to protect the patient and minimize exposure to potentially harmful organisms.

Thermoregulatory Alterations

Integumentary loss also results in an inability to regulate body temperature. Patients with burn injuries may, therefore, exhibit low body temperatures in the early hours after injury. Hostler, Weaver, Ziembicki, et al. (2013) found that hypothermia (i.e., core temperature less than 36.5°C [97.7°F]), on admission of patients to the hospital was an independent predictor of mortality. Intraoperative hypothermia, exacerbated by exposure during prolonged surgeries, combined with general anesthesia's blunting of metabolic and neurologic hypothermic responses, also poses challenges to successfully treating patients with major burns (Davis, Rodriquez, Quintana, et al., 2013). Burn centers have heat panels at the bedside as additional heating sources to help maintain the patient's body temperature through environmental warming. After the initial few hours, persistent increases in baseline core temperature ensues as part of the physiologic and metabolic response to a burn injury (Snell et al., 2013).

Gastrointestinal Alterations

Patients who are critically ill, including those with burns, are predisposed to altered GI motility. Impaired enteric nerve and smooth muscle function, inflammation, surgery, medications such as vasopressors, and inadequate tissue perfusion are some causes of GI dysfunction. Indicators of GI organ ischemia include increased bladder pressure, increasing serum lactate, and feeding intolerance (Trexler, Lundy, Chung, et al., 2014). Three of the most common GI alterations in patients with burns are paralytic ileus (absence of intestinal peristalsis), Curling's ulcer, and

translocation of bacteria. Decreased peristalsis and bowel sounds are manifestations of paralytic ileus. Gastric distention and nausea may lead to vomiting; therefore, gastric decompression is advised. Gastric bleeding secondary to massive physiologic stress may be signaled by occult blood in the stool, regurgitation of "coffee ground" material from the stomach, or bloody vomitus. These signs suggest gastric or duodenal erosion (Curling's ulcer).

Patients with large TBSA burns are also at risk for life-threatening ACS due to large volumes of fluid required for resuscitation, fluid shifts to the interstitium causing edema formation, and decreased abdominal wall compliance due to eschar formation. Increased pressure in the abdominal cavity contributes to GI tract and abdominal organ ischemia (see Chapter 8).

Management of Burn Injury

Burn care is typically categorized into three phases of care: emergent/resuscitative, acute/intermediate, and rehabilitation. Although priorities exist for each of the phases, assessment and management of problems and complications will overlap. Table 47-3 summarizes the priorities of care for each phase.

Emergent/Resuscitative Phase

On-the-Scene Care

The first step in management is to remove the patient from the source of injury and stop the burning process while preventing injury to the rescuer. Rescue workers' priorities include establishing an airway, supplying oxygen (100% oxygen if carbon monoxide poisoning is suspected), inserting at least one large-bore IV line, and covering the wound with a clean, dry cloth or gauze. Continuous irrigation of chemical injury must begin immediately. Chart 47-4 describes the procedures and care required at the burn scene. The outward physical appearance of the person who has been burned is often distracting, but it is the internal systemic effects that pose greater threats to life.

An immediate primary survey of the patient is carried out to assess the ABCDEs: *a*irway (A) with consideration given to protecting the cervical spine, gas exchange or *b*reathing (B), *c*irculatory and *c*ardiac status (C), *d*isability (D) including neurologic deficit, and *e*xpose and *e*xamine (E) while maintaining a warm environment (ABA, 2011).

Chart 47-4

Emergency Procedures at the Burn Scene

- **Extinguish the flames or remove from source.** When clothing catches fire, the flames can be extinguished if the person drops to the floor or ground and rolls ("stop, drop, and roll"); anything available to smother the flames, such as a blanket, rug, or coat, may be used. The older adult, or others with impaired mobility, could be instructed to "stop, sit, and pat" to prevent concomitant musculoskeletal injuries. Standing still forces the person to breathe flames and smoke, and running fans the flames. If the burn source is electrical, the electrical source must be disconnected safely before moving the patient.
- **Cool the burn.** After the flames are extinguished, the burned area and adherent clothing are soaked with *cool* water, *briefly,* to cool the wound and halt the burning process. However, *never* apply ice directly to the burn, *never* wrap the person in ice, and *never* use cold soaks or dressings for longer than several minutes; such procedures may worsen tissue damage and lead to hypothermia in people with large burns.
- **Remove restrictive objects.** If possible, remove clothing immediately. Adherent clothing may be left in place once cooled. Other clothing and all jewelry, including all piercings, should be removed to allow for assessment and to prevent constriction secondary to rapidly developing edema.
- **Cover the wound.** The burn should be covered as quickly as possible to minimize bacterial contamination, maintain body temperature, and decrease pain by preventing air currents from coming in contact with the injured surface. Any clean, dry cloth can be used as an emergency dressing. Ointments and salves should *not* be used. Other than the dressing, no medication or material should be applied to the burn wound at the scene.
- **Irrigate chemical burns.** Chemical burns resulting from contact with a corrosive material are irrigated immediately. Most chemical laboratories have a high-pressure shower for such emergencies. If such an injury occurs at home, brush off the chemical agent, remove clothes immediately, and rinse all areas of the body that have come in contact with the chemical. Rinsing can occur in the shower or any other source of continuous running water. If a chemical gets in or near the eyes, the eyes should be flushed with cool, clean water immediately. Outcomes for the patient with chemical burns are significantly improved by rapid, sustained flushing of the injury at the scene.

Adapted from American Burn Association. (2011). Advanced burn life support (ABLS) course provider manual 2011. Chicago, IL: Author.

TABLE 47-3 Phases of Burn Care

Phase	Duration	Priorities
Emergent/resuscitative	From onset of injury to completion of fluid resuscitation	• Primary survey: A, B, C, D, E • Prevention of shock • Prevention of respiratory distress • Detection and treatment of concomitant injuries • Wound assessment and initial care
Acute/intermediate	From beginning of diuresis to near completion of wound closure	• Wound care and closure • Prevention or treatment of complications, including infection • Nutritional support
Rehabilitation	From major wound closure to return to individual's optimal level of physical and psychosocial adjustment	• Prevention and treatment of scars and contractures • Physical, occupational, and vocational rehabilitation • Functional and cosmetic reconstruction • Psychosocial counseling

Adapted from American Burn Association. (2011). Advanced burn life support (ABLS) course provider manual 2011. Chicago, IL: Author; Serghiou, M. A., Ott, S., Whitehead, C., et al. (2012). Comprehensive rehabilitation of the burn patient. In D. Herndon (Ed.). Total burn care (4th ed.). Edinburgh: Saunders Elsevier.

Nursing Alert: Airway patency and breathing must be assessed during the initial minutes of emergency care. Immediate therapy is directed toward establishing a patent airway and giving humidified 100% oxygen. If qualified personnel and equipment are available and the victim has severe respiratory distress and/or airway edema, the rescuers must insert an endotracheal tube and initiate mechanical ventilation.

Nursing Alert: No food or fluid is given by mouth, and the patient is placed in a position that will prevent aspiration of vomitus, because nausea and vomiting may occur and protection of the airway is always a priority.

The secondary survey focuses on obtaining a history, the completion of the total body system assessment, initial fluid resuscitation, and provision of psychosocial support of the conscious patient (see Chapter 60) (ABA, 2011).

Medical Management

Long-term outcomes are impacted by the quality of care received in the first few hours after injury (Kearns et al., 2013). Initially, the patient is transported to the nearest emergency department (ED) so that lifesaving measures can be initiated, and early referral to a burn center is made if indicated.

Initial priorities in the ED remain airway, breathing, and circulation. For mild pulmonary injury, 100% humidified oxygen is given, and the patient is encouraged to cough so that secretions can be expectorated or removed by suctioning. For more severe situations, it may be necessary to remove secretions by bronchial suctioning and to give bronchodilators and mucolytic agents. It is essential to continuously monitor airway patency, because a previously stable airway may rapidly deteriorate as edema increases and toxic effects of smoke inhalation become apparent.

Once urgent respiratory needs are appropriately addressed, fluid resuscitation is initiated in burns greater than 20% TBSA to maintain adequate organ perfusion. Baseline weight and laboratory test results are obtained, and these parameters must be monitored closely in the immediate post-burn (resuscitation) period. Both under-resuscitation and over-resuscitation with IV fluids are associated with poor outcomes. Shock, ischemic complications, and multiple organ dysfunction syndrome (MODS) occur with under-resuscitation (see Chapter 8), and heart failure and pulmonary edema occur with over-resuscitation (see Chapter 23).

In order to facilitate fluid administration, peripheral IV access may be initially obtained; however, in larger burns, central venous access is recommended due to the large volume required. TBSA is calculated and fluid resuscitation with lactated Ringers (LR) should be initiated using ABA fluid resuscitation formulas. LR is the crystalloid of choice because its pH and osmolality most closely resemble human plasma.

The ABA (2011) fluid resuscitation formula for adults within 24 hours post thermal or chemical burn is as follows:

2 mL LR × patient's weight in kilograms × %TBSA second-, third-, and fourth-degree burns

For adults with electrical burns:

4 mL LR × patient's weight in kilograms × % TBSA second-, third-, and fourth-degree burns

Other commonly recommended formulas for fluid resuscitation (Gupta, Asirvatham, Reddy, et al., 2021) are as follows:

- Evans formula: 1 mL NS/kg/% TBSA and 1 mL colloid/kg/% TBSA plus 2 L of 5% dextrose
- Brookes formula: 1.5 mL crystalloid/kg/% TBSA and 0.5 mL colloid/kg/% TBSA plus 2 L of 5% dextrose
- Modified Parkland formula: 4 mL RL/kg/% TBSA

The infusion is regulated so that one half of the total calculated volume is given in the first 8 hours post-burn injury. The second half of the calculated volume is given over the next 16 hours. Timing is one of the most important considerations in calculating fluid needs in the first 24 hours post burn. The starting point is the time of injury—not the time of arrival to the treating facility (ABA, 2011).

These formulas are only a guideline. It is imperative that the rate of infusion be titrated hourly as indicated by physiologic monitoring of the patient's response. For adults, a urine output of 0.5 to 1 mL/kg/h is used as an indication of appropriate resuscitation in thermal and chemical injuries, whereas in electrical injuries a urine output of 75 to 100 mL/h is the goal (ABA, 2011). Other indicators such as blood pressure and heart rate are not useful in assessing adequate intravascular volume in patients with major burns.

After adequate respiratory function and circulatory status have been established, the patient is assessed for cervical spine and/or head injuries if involved in a traumatic or electrical injury. All clothing and jewelry are removed because they may contain chemicals, retain heat, or become constrictive as edema rapidly develops. For chemical burns, flushing of the exposed areas with copious amounts of clean water is continued. The patient is checked for contact lenses. These are removed immediately if chemicals have come in contact with the eyes or if facial burns have occurred. In addition, the eyes are examined promptly for injury to the corneas. An ophthalmologist may be consulted for complete assessment via fluorescent staining to assess for corneal damage.

The patient's temperature must be monitored because hypothermia may develop rapidly and manipulation of the environment may be necessary. A temperature less than 35°C (95°F) causes vasoconstriction, which may increase tissue ischemia and necrosis.

It is important to validate an account of the burn scenario provided by the patient, witnesses at the scene, and first responders. Information should include the time and the source of the burn injury, the scene of injury (particularly if the patient was in an enclosed space), length of exposure, prior treatment, and any history of concomitant traumatic injury. A history of preexisting medical conditions, allergies, medications, and the use of drugs, alcohol, and tobacco is obtained to assist with the treatment plan.

An indwelling urinary catheter is inserted to permit accurate monitoring of urine output and as a measure of kidney function and fluid needs for patients with moderate to severe burns. If the burn exceeds 20% to 25% TBSA, a nasogastric tube is inserted and connected to low intermittent suction. All patients who are intubated should have a nasogastric tube inserted to decompress the stomach, and to prevent vomiting and aspiration. Often, patients with large burns become nauseated as a result of the GI effects of the burn injury, such as paralytic ileus, and the effects of medications such as opioids.

Clean sheets are placed under and over the patient to protect the burn wound from contamination, maintain body

temperature, and reduce pain caused by air currents passing over exposed nerve endings. Baseline height, weight, arterial blood gases, hematocrit, serum electrolytes, blood alcohol level, drug panel, urinalysis, and chest x-rays may be obtained. Because poor tissue perfusion accompanies burn injuries, only IV analgesia is given in small repeated doses, which is crucial for pain reduction in the emergent phase. If the patient has an electrical burn, a baseline electrocardiogram is also obtained and continuous cardiac monitoring is initiated. Because burns are contaminated wounds, tetanus prophylaxis is given if the patient's immunization status is not current or is unknown.

Nursing Alert: If necessary, a blood pressure cuff can be placed around a patient's burned extremity. The cuff must be of the correct size with accommodations made for edema.

Although the major focus of care during the emergent phase is physical stabilization, the nurse must also attend to the patient's and the family's psychological needs. Anxiety accompanies burn injuries and must be addressed on an ongoing basis. Burn injury is a crisis—one that causes varying emotional responses that may result in conflicts that may cause ethical dilemmas (see Chart 47-5). The patient's and family's coping abilities and available supports are assessed. The nurse must consider special circumstances surrounding the burn injury when providing care. Examples include cases of abuse, neglect, suicide attempts, and injury/death of other family members or friends from the same event.

Nursing Management

Nursing assessment in the emergent phase of burn injury focuses on the major priorities for any trauma patient; the burn wound is a secondary consideration to stabilization of airway,

Chart 47-5 ETHICAL DILEMMA

How Much is Enough and What is Comfort Care?

Case Scenario

A 66-year-old man was transported to the nearest burn center, where you work as a staff nurse. He was drinking beer and cooking steaks on top of a propane grill. He inexplicably threw lighter fluid on the grill and it engulfed his upper torso and face in flames. He sustained a full-thickness burn to 42% of his body (face, neck, both arms, and chest). He was awake at the scene of injury when paramedics arrived and indicated a past medical history of hypertension, hypercholesterolemia, and gout. He was in little pain at the time due to the depth of the burn injury; however, he was asking the team questions related to the survivability of his injury, "Am I going to die?"

Given the extensiveness of his facial burns, he was intubated upon admission to the burn center. Family arrived, and the burn surgeon explained the extent of injury. A decision was made to proceed with care and assess his progress post resuscitation. They were prepared for a future decision regarding withdrawal of care if survival becomes futile.

Initial resuscitation has occurred, and approximately 4 days post burn, the patient begins to show signs of acute kidney injury. He has had one surgical procedure for débridement and grafting to his chest, and although grafts are intact, they do not look healthy. He is showing increased signs of discomfort and pain due to the operative procedure and the addition of another wound (the new donor site). In a team meeting, the family decides that they do not want to initiate hemodialysis and therefore place the patient on comfort measures. Approximately 3 days later, he remains on comfort care and has increased signs of restlessness and pain. You are caring for the patient and request that the physician prescribe an increase in pain medication from 5 mg morphine to 8 mg IV. Within 2 hours after administration, the patient expired without discomfort. Six months later, the facility is contacted by an attorney and informed that the family is taking legal action against you and the physician for performing euthanasia on the patient.

Discussion

Clinicians on burn teams commonly face these types of ethical dilemmas. Whenever possible, the team should attempt to elicit the patient's wishes as early as possible, including any advance directives. It is important to collaborate and communicate with the family regarding end of life care. Although the family agreed to "comfort care," there may have been ambiguity regarding what this entails. The problem in this case is that due to absence of pain, it is often difficult for a patient to understand the severity of their burn injury. The patient begins to experience increased pain as care progresses, and increased medication is expected. As the medication is increased to relieve pain and suffering but death ensued, the *Doctrine of Double Effect* comes into play. The medication given relieved the pain and suffering but the "bad" effect or death occurred. In such cases, the outcome may be predicted but it is not the intention of the intervention.

Analysis

- Describe the ethical principles that are in conflict in this case (see Chapter 2, Chart 2-3). Which principle should have preeminence as you proceeded to work with this family?
- Would you describe your role in this case as complicit with assisted suicide, active euthanasia, or providing palliation? What distinction, if any, might there be among these three acts? Do you believe that this was a survivable injury?
- Describe how the ethical principles of autonomy, beneficence, and nonmaleficence may intersect or be at odds with each other in this case (Chapter 2, Chart 2-3). As a member of the burn team when the patient arrived at your facility, what could you have done differently to ensure that the patient's autonomy was preserved before he was intubated?
- What were the "intentions" in this case? How might intentionality be instrumental in making this act of titrating medications that provided palliation morally defensible? Is this nursing intervention morally defensible according to the principle of double effect (see Chapter 2, Chart 2-3)?
- Note that the American Nurses Association (2015) *Code of Ethics* clearly states that nurses should not *intentionally* cause a patient's death.

References

American Nurses Association. (2015). Code of ethics for nurses with interpretive statements. Washington, DC: American Nurses Publishing, American Nurses Foundation/American Nurses Association.

Beauchamp, T. L., & Childress, J. F. (2012). Principles of biomedical ethics (7th ed.). New York: Oxford University Press.

Resources

ICN code of ethics
Code of Ethics for Nurses in INDIA
See Chapter 2, Chart 2-6, for ethics resources.

breathing, and circulation. Respiratory status is monitored closely, and pulses are evaluated, particularly in areas of circumferential burn injury to an extremity. Cardiac monitoring is indicated initially if the patient has a history of cardiac disease, electrical injury, or respiratory conditions. Vital signs and hemodynamic status are monitored closely with awareness of expected abnormalities consistent with burn injury such as tachycardia and tachypnea.

If all extremities are burned, determining blood pressure may be difficult. A clean dressing applied under the blood pressure cuff protects the wound from contamination. Because increasing edema makes blood pressure difficult to auscultate, a Doppler (ultrasound) device or a noninvasive electronic blood pressure device may be helpful. In patients with severe burns, an arterial catheter is used for blood pressure measurement and for collecting blood specimens. Peripheral pulses of burned extremities are checked frequently, either by palpation or the use of a Doppler if necessary. Elevation of burned extremities above the level of the heart is necessary to decrease edema. Large-bore IV catheters (e.g., 14 to 18 gauge) and an indwelling urinary catheter are inserted, if not already in place, and the nurse's assessment must include hourly assessment of intake and urine output.

Red-colored urine suggests the presence of hemochromogens from damage to red blood cells and myoglobin resulting from muscle damage. These are associated with deep burns caused by electrical injury or prolonged contact with heat or flame. Glycosuria, a common finding in the early post-burn hours, results from the release of liver glycogen stores in response to stress.

The nurse assists with calculating the patient's expected fluid requirements and monitoring the patient's response to fluid resuscitation. Nurse-driven resuscitation protocols can improve patient outcomes in the emergent/resuscitative phase (Fahlstrom, Boyle, & Makic, 2013). Nursing responsibilities include administration of fluids, strict monitoring of fluid intake and output, monitoring patient response, and notifying the treatment team of significant assessment findings and any abnormal laboratory values.

To help guide treatment, the following are essential: documentation of body temperature, body weight, and pre-burn weight; history of allergies, tetanus immunization, past medical and surgical history, and current illnesses; and a list of current medications. A head-to-toe assessment is performed, focusing on signs and symptoms of concomitant illness, associated injury, or developing complications. Assessing the extent of the burn wound using the rule of nines or facilitated with anatomic diagrams (described previously) is performed. In addition, the nurse works with the primary provider to clinically assess the initial areas of full- and partial-thickness injury. Psychosocial considerations of the patient and family and communication with the treatment team are imperative early in the course of care.

Nursing care of the patient during the emergent/resuscitative phase of burn injury is detailed in Chart 47-6.

Acute/Intermediate Phase

The acute/intermediate phase of burn care follows the emergent/resuscitative phase and begins 48 to 72 hours after the burn injury. During this phase, attention is directed toward continued assessment and maintenance of respiratory and circulatory status, fluid and electrolyte balance, and GI and kidney function. Infection prevention, burn wound care (e.g., wound cleaning and débridement, topical antibacterial therapy, application of dressings, and wound grafting), pain management, modulation of the hypermetabolic response, and early positioning/mobility are priorities at this stage and are discussed in detail in the following sections.

Medical Management

Pulmonary complications are common in burn injury. Airway obstruction caused by upper airway edema can take as long as 48 hours to develop. Changes detected by x-ray and arterial blood gas analysis may occur as the effects of resuscitative fluid and the chemical reactions of smoke ingredients with lung tissues become apparent. Diagnosis is largely based on history and clinical presentation, monitoring of arterial blood gases with carboxyhemoglobin levels, and direct observation of the airway by fiberoptic bronchoscopy (Dries & Endorf, 2013). To lessen the effects of upper airway edema, elevation of the patient's head of the bed may be helpful. Stridor and dyspnea are ominous because they are late signs of impending airway obstruction. Early protective intubation to maintain airway patency should be considered as obstruction may occur very rapidly. However, intubation and mechanical ventilation are significant contributors to pulmonary infections. Ideally, the best practice is to remove the endotracheal tube as soon as possible so that a route for pathogens is not accessible to the lungs.

Late pulmonary complications secondary to inhalation injuries include mucosal sloughing of the airway and casts formed from cellular debris, which can lead to obstruction, increased secretions, inflammation, atelectasis, airway ulceration, pulmonary edema, and tissue hypoxia (Snell et al., 2013). Pneumonia, acute lung injury (ALI), and ARDS may also occur.

Ventilator-associated pneumonia (VAP) is one complication of any patient who is hospitalized and mechanically ventilated, and is particularly exacerbated in the patient with an inhalation injury. It affects as many as 10% to 20% of patients on mechanical ventilation longer than 48 hours. See Chapter 11, Chart 11-11, for discussion of "bundled" strategies to prevent VAP and Chapter 12 for discussion of respiratory failure and ARDS.

As capillaries regain integrity, 48 or more hours after the burn, fluid moves from the interstitial to the intravascular compartment and intrinsic diuresis begins. If cardiac or kidney function is inadequate, fluid overload may occur and symptoms of heart failure may result (see Chapter 23). Administration of fluids and electrolytes continues cautiously during this phase of burn care due to fluid shifts, evaporative fluid loss from large burn wounds, and the patient's physiologic responses to the burn injury. Blood components are given as needed to treat surgical blood loss and anemia.

Hyperthermia is common in patients after burn shock resolves. A resetting of the core body temperature in patients who are severely burned results in a body temperature a few degrees higher than normal for several weeks after the burn. This can be compounded by body temperature increases from sepsis.

Central venous, peripheral arterial, or specialty catheters may be required for monitoring hemodynamics. It is not uncommon for patients with major burns to have multiple invasive line sites due to the amount and frequency of fluid and medication that need to be given. Whenever possible, burned areas of the body are avoided as insertion sites for invasive lines.

One of the most important medical interventions for patients with burns that has positively impacted mortality is early excision. Through surgical excision, the necrotic tissue is removed and underlying viable tissue is preserved. Early excision of dead tissue with wound closure and/or application

Chart 47-6 PLAN OF NURSING CARE

Care of the Patient During the Emergent/Resuscitative Phase of Burn Injury

NURSING DIAGNOSIS: Impaired gas exchange related to carbon monoxide poisoning, smoke inhalation, and upper airway obstruction
GOAL: Maintenance of adequate tissue oxygenation

Nursing Interventions	Rationale	Expected Outcomes
1. Provide 100% humidified oxygen.	1. Humidification provides moisture to injured tissues; supplemental oxygen increases alveolar oxygenation.	• Absence of dyspnea • Arterial oxygen saturation >95% by pulse oximetry • Arterial blood gas levels within normal limits • Respiratory rate, pattern, and breath sounds normal
2. Assess breath sounds, and respiratory rate, rhythm, depth, and symmetry of chest excursion. Monitor patient for signs of hypoxia. Report abnormalities to primary provider	2. These factors provide baseline data of assessment and evidence of increasing respiratory compromise.	
3. Observe for the following: a. Erythema or blistering of lips or buccal mucosa b. Singed nasal hairs c. Burns of face, neck, or chest d. Increasing hoarseness e. Soot in sputum or tracheal tissue in respiratory secretions	3. These signs indicate possible inhalation injury and risk of respiratory dysfunction.	
4. Monitor arterial blood gas values, pulse oximetry readings, and carboxyhemoglobin levels.	4. Increasing $PaCO_2$ and decreasing PaO_2 and O_2 saturation may indicate need for mechanical ventilation.	
5. Prepare to assist with intubation and escharotomies of chest.	5. Intubation allows airway protection and mechanical ventilation. Escharotomy enables adequate chest excursion in circumferential chest burns.	

NURSING DIAGNOSIS: Ineffective airway clearance related to edema and effects of smoke inhalation
GOAL: Maintain patent airway and adequate airway clearance

Nursing Interventions	Rationale	Expected Outcomes
1. Maintain patent airway through proper patient positioning, removal of secretions, and artificial airway if needed.	1. A patent airway is crucial to respiration.	• Patent airway • Respiratory secretions are minimal, colorless, and thin
2. Provide humidified oxygen as prescribed.	2. Humidification liquefies secretions and facilitates expectoration.	
3. Encourage patient to turn, cough, and deep breathe. Encourage patient to use incentive spirometry. Suction as needed.	3. These activities promote mobilization and removal of secretions.	

NURSING DIAGNOSIS: Deficient fluid volume related to increased capillary permeability and evaporative losses from the burn wound
GOAL: Restoration of optimal fluid and electrolyte balance and perfusion of vital organs

Nursing Interventions	Rationale	Expected Outcomes
1. Monitor vital signs, hemodynamics, and urine output, as well as strict intake and output and daily weight.	1. Hypovolemia is a major risk immediately after the burn injury. Overresuscitation might cause fluid overload.	• Urine output between 0.5 and 1.0 mL/kg/h (30–50 mL/h; 75–100 mL/h if electrical burn injury) • Mean arterial pressure ≥60 mm Hg • Voids clear yellow urine with specific gravity within normal limits • Serum electrolytes within normal limits
2. Maintain IV lines and regulate fluids at appropriate rates, as prescribed.	2. Adequate fluids are necessary for perfusion of vital organs and maintenance of fluid and electrolyte balance.	
3. Observe for symptoms of deficiency or excess of serum sodium, potassium, calcium, phosphorus, and bicarbonate.	3. Rapid shifts in fluid and electrolyte status are possible in the post-burn period.	
4. Elevate head of patient's bed, and elevate burned extremities.	4. Elevation promotes venous return.	
5. Notify physician immediately of decreased urine output and hemodynamic changes.	5. Rapid fluid shifts must be detected early to prevent complications.	

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NURSING DIAGNOSIS: Hypothermia related to loss of skin microcirculation and open wounds
GOAL: Maintenance of adequate body temperature

Nursing Interventions	Rationale	Expected Outcomes
1. Assess core body temperature frequently.	1. Frequent temperature assessments help detect hypothermia.	• Body temperature remains >37°C (98.6°F) • Absence of chills or shivering
2. Provide a warm environment by increasing room temperature or adjunct therapies as needed (overbed warmers, blankets, heat lamps, etc.)	2. Minimizes energy expenditure.	
3. Work quickly when wounds must be exposed.	3. Limiting exposure minimizes evaporative heat loss from wound.	

NURSING DIAGNOSIS: Acute pain related to tissue and nerve injury
GOAL: Control of pain

Nursing Interventions	Rationale	Expected Outcomes
1. Use pain intensity scale to assess pain level. Differentiate restlessness due to pain from restlessness due to hypoxia.	1. Pain level provides baseline for evaluating effectiveness of pain relief measures. Hypoxia can cause similar signs and must be ruled out before analgesic medication is given.	• States pain level is decreased and is acceptable to patient's pain goal • Absence of nonverbal cues of pain
2. Administer IV analgesics as prescribed and assess for effectiveness.	2. IV administration is necessary because of altered tissue perfusion from burn injury.	
3. Provide emotional support and reassurance.	3. Fear and anxiety increase the perception of pain.	

NURSING DIAGNOSIS: Anxiety related to fear and the emotional impact of burn injury
GOAL: Minimization of patient's and family's anxiety

Nursing Interventions	Rationale	Expected Outcomes
1. Assess patient's and family's understanding of burn injury, coping skills, and family dynamics.	1. Previous successful coping strategies can be fostered for use in the present crisis. Assessment allows planning of individualized interventions.	• Patient and family verbalize understanding of emergent burn care • Patient and family's anxiety levels will be minimized
2. Explain all procedures to the patient and the family in clear, simple terms.	2. Increased understanding alleviates fear of the unknown. High levels of anxiety may interfere with understanding of complex explanations.	
3. Consider administering prescribed antianxiety medications if the patient remains extremely anxious despite nonpharmacologic interventions.	3. Anxiety levels during the emergent phase may exceed the patient's coping abilities.	

COLLABORATIVE PROBLEMS: Acute respiratory failure, distributive shock, acute kidney injury, compartment syndrome, paralytic ileus, Curling's ulcer
GOAL: Absence of complications

Nursing Interventions	Rationale	Expected Outcomes
Acute Respiratory Failure		
1. Assess for increasing dyspnea, stridor, changes in respiratory patterns.	1. Such signs reflect deteriorating respiratory status.	• Breathes spontaneously with adequate tidal volume • Arterial blood gas values within acceptable limits • Chest x-ray findings normal • Absence of cerebral signs of hypoxia
2. Monitor pulse oximetry, arterial blood gas values.	2. Abnormal findings may indicate respiratory failure.	
3. Monitor chest x-ray results.	3. X-ray may disclose pulmonary injury.	

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4. Assess for restlessness, confusion, difficulty attending to questions, or decreasing level of consciousness.	4. Such manifestations may indicate cerebral hypoxia.	
5. Report deteriorating respiratory status immediately to primary provider.	5. Acute respiratory failure is life threatening, and immediate intervention is required.	
6. Prepare to assist with intubation or escharotomies as indicated.	6. Intubation allows mechanical ventilation. Escharotomies allow adequate chest excursion with respirations.	
Distributive Shock		
1. Assess for decreasing urine output and alterations in vital signs and hemodynamics.	1. Such signs and symptoms may indicate distributive shock and inadequate intravascular volume.	• Urine output between 0.5 and 1.0 mL/kg/h (30–50 mL/h; 75–100 mL/h if electrical burn injury) • Blood pressure within patient's normal range • Hemodynamics remain within normal limits • No signs or symptoms of impaired perfusion
2. Assess for progressive edema as fluid shifts occur.	2. As fluid shifts into the interstitial spaces in burn shock, edema occurs and may compromise tissue perfusion.	
3. Adjust fluid resuscitation in collaboration with the primary provider in response to physiologic findings.	3. Optimal fluid resuscitation prevents distributive shock and improves patient outcomes.	
Acute Kidney Injury		
1. Monitor urine output, blood urea nitrogen (BUN), and serum creatinine levels.	1. These values reflect renal function.	• Adequate urine output • BUN and serum creatinine values remain normal
2. Report decreased urine output or increased BUN and creatinine values to primary provider.	2. These laboratory values indicate possible kidney failure.	
3. Assess urine for hemoglobin or myoglobin. Administer increased fluids as prescribed.	3. Hemoglobin or myoglobin in the urine predisposes patient to increased risk of kidney failure. Fluids help to flush hemoglobin and myoglobin from renal tubules.	
Compartment Syndrome		
1. Assess peripheral pulses frequently with Doppler ultrasound device if needed.	1. Pulse assessments are crucial to assess for adequate perfusion.	• Peripheral pulses detectable • Signs of adequate peripheral perfusion
2. Assess warmth, capillary refill, sensation, and movement of extremity frequently. Compare affected with unaffected extremity.	2. These assessments may signal worsening peripheral perfusion.	
3. Remove blood pressure cuff after each reading.	3. Cuff may act as a tourniquet as extremities swell.	
4. Elevate burned extremities.	4. Elevation reduces edema formation.	
5. Report loss of pulse or sensation or presence of pain to primary provider immediately.	5. These signs and symptoms may indicate impaired tissue perfusion.	
6. Prepare to assist with escharotomies.	6. Escharotomies relieve the constriction caused by edema.	
Paralytic Ileus		
1. Auscultate for bowel sounds, abdominal distention.	1. Presence of bowel sounds indicates normal peristalsis. Abdominal distention reflects inadequate decompression.	• Normal bowel sounds • Absence of abdominal distention
2. Maintain nasogastric tube on low intermittent suction until bowel sounds resume.	2. This measure relieves gastric and abdominal distention.	
Curling's Ulcer		
1. Assess gastric aspirate and stools for blood.	1. Blood indicates possible gastric or duodenal ulcer bleeding.	• Gastric aspirate and stools do not contain blood
2. Administer histamine-2 blockers and/or antacids as prescribed.	2. Such medications reduce gastric acidity and risk of ulceration.	

of biologic or synthetic wound covering reduces the effects of inflammatory mediators that cause pathophysiologic abnormalities (Rousseau et al., 2014).

Infection Prevention

There are multifactorial reasons why patients with burns incur some of the highest risks for health care–associated infections (HAIs). These reasons may include loss of the barrier function of the skin for protection against invasive microorganisms; necrotic tissue in burn eschar combines with serum proteins to produce an environment conducive to bacterial growth; and the effects of thermal injury compromise both cell-mediated and systemic intrinsic immunity, thus promoting an environment conducive to pathogen proliferation (Abdullahi & Jeschke, 2014). Pathogens can be transmitted directly by health care staff through contact or droplets, or indirectly through the environment or equipment (Meyerson et al., 2015). It is, therefore, critical that the nurse prioritizes infection prevention in the plan of care.

Causative agents of burn infections may include bacteria, fungi, or viruses. Common sources of potential contamination in a burn unit that require hypervigilance include hydrotherapy equipment, direct or indirect contamination from health care workers' hands, environmental surfaces, and translocation of microorganisms from other body systems—most notably, the GI tract. Whether the burn wound is healing through spontaneous re-epithelialization or is being prepared for skin grafting, it must be protected from pathogens. Infection impedes burn wound healing by promoting excessive inflammation and damaging tissue. Clinical signs of infection include progressive erythema, warmth, tenderness, and malodorous exudate.

A multiple-strategy approach is crucial in prevention and control of burn wound infections. Such strategies include (Mayhall, 2012):

- The use of barrier techniques (e.g., gowns, gloves, eye protection, and masks if needed)
- Environmental cleaning with periodic cultures of patient care equipment (with special attention to hydrotherapy equipment)
- Application of appropriate topical antimicrobial agents
- Appropriate use of systemic antibiotic and antifungal agents (careful use and close monitoring of culture sensitivities are needed due to increasing challenges of antibiotic resistance in health care environments)
- Early excision and closure of the burn wound
- Control of hyperglycemia (with insulin as indicated, even in a patient without a prior diagnosis of diabetes)
- Management of the hypermetabolic response (see Chapter 8)

There are varying practices in the burn community regarding environmental and patient cultures for surveillance. In some burn centers, patients may be cultured on admission to screen for the presence of methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci. Wounds are generally cultured on admission, with each surgical case, and for clinical suspicion of infection. Antimicrobial therapy is tailored to culture results.

Wound Cleaning

Proper management of burn wounds is required to prevent wound deterioration. The goal of wound care is to remove nonviable tissue and wound exudate, and eliminate previously applied topical agents. Gentle cleaning with mild soap, water, and a washcloth can prevent infection by decreasing bacteria and debris on the wound surface. Hair in and around the burn area, except the eyebrows, should be clipped short or shaved.

Various processes are used to clean the burn wound. Patients who are hemodynamically unstable may have their wounds washed at the bedside, whereas patients who are ambulatory may shower. The wounds of patients who are nonambulatory can be cleaned using shower carts—mobile stretchers made with removable sides, drainage holes, and positioning capabilities. Retractable shower hoses suspended from walls and ceilings provide the nurse with easy access to a clean water source for washing the wounds. Whatever method is used, the goal is to protect the wound from acute proliferation of pathogenic organisms on the surface and invasion of deeper tissues until either spontaneous healing or skin grafting can be achieved. Strategies for the prevention of cross-contamination include the use of plastic liners, water filters, and thorough decontamination of equipment.

Patient comfort and ability to participate in the prescribed treatment are important considerations. During bathing, patient participation is encouraged to promote exercise of the extremities. At the time of wound cleaning, all skin is inspected for any signs of redness, breakdown, or local infection. This also provides the nurse an opportunity for patient education. Encouraging family presence during wound care can improve patient and family satisfaction, nursing communication, and optimize patient outcomes (see Chart 47-7) (Bishop, Walker, & Spivak, 2013).

During treatment, the patient is continuously assessed for signs of hypothermia. The temperature of the water is maintained at 37.8°C (100°F), and the temperature of the room should be maintained between 26.6° and 29.4°C (80° and 85°F) to prevent hypothermia. Other assessment considerations include patient fatigue, changes in hemodynamic status, and pain unrelieved by analgesic medications or relaxation techniques.

Topical Antibacterial Therapy

Variations in topical wound care for nonsurgical burn wounds exist among burn centers across the country, and choices are made based on the individualized needs of each patient. The goal of topical therapy is to provide a dressing with the following characteristics:

- Is effective against gram-positive and gram-negative organisms and fungi
- Penetrates the eschar but is not systemically toxic
- Is cost-effective, available, and acceptable to the patient
- Is easy to apply and remove, and decreases the frequency of dressing changes, decreases pain, and minimizes nursing time

No single topical medication is universally effective, and the use of different agents at different times in the post-burn period may be necessary.

Nursing Alert: Prudent use and alternation of antimicrobial agents can result in reduction of resistant strains of bacteria, greater effectiveness of the agents, and a decreased risk of sepsis. Table 47-4 describes selected topical antimicrobial agents.

Wound Dressing

After the prescribed topical agents are applied, the wound is covered with several layers of dry dressings with lighter dressing over joints to allow for mobility. Dressings may also need to be modified to accommodate splints or other positioning devices. Circumferential dressings should always be applied distally to proximally in order to promote return of excess fluid to the central circulation. If the hand or foot is burned, the fingers and

Chart 47-7 NURSING RESEARCH PROFILE

Family Presence During Dressing Changes in the Burn Unit

Bishop, S. M., Walker, M. D., & Spivak, I. M. (2013). Family presence in the adult burn intensive care unit during dressing changes. Critical Care Nurse, 33(1), 14–23.

Purpose

Severe burn injuries are often devastating events that can disrupt family dynamics. Staff working in burn units have traditionally forbidden visitation during dressing changes, even though the American Association of Critical Care Nurses and the American College of Critical Care Medicine both recommend family presence during procedures. However, there is no evidence that family presence during dressing changes in burn units has any effect on patient satisfaction with care. This quality improvement project sought to find out if family presence during dressing changes would have any association with patient satisfaction and rates of infections.

Design

The setting for this quality improvement project was a five-bed burn intensive care unit located within a 404-bed urban level 1 trauma center, which admits, on average, 130 patients with burns each year. This academic medical center utilizes a patient- and family-centered care (PFCC) model. The central tenet of the PFCC model is that the patient is a reflection of the family unit and that the family is central to the patient's well-being. Core concepts inherent in this model include dignity and respect, collaboration, participation, and information sharing. Although there was no research-based evidence that demonstrated that family presence during dressing changes would improve patient satisfaction, tenets of the PFCC model supported that this would be the case. Patients and their family members were invited to observe dressing changes, and, if they consented, were instructed in appropriate infection control protocols. Patient satisfaction scores on key Press Ganey Likert scale metrics were used pre- and postimplementation to find if patient satisfaction improved postintervention. Likewise, rates of hospital care–associated infections (HAIs) pre- and postintervention were compared.

Findings

Thirty seven Press Ganey patient satisfaction survey results obtained postintervention (March 2009 through December 2011) were compared to thirty five survey results obtained pre-intervention (January 2007 through February 2009). Each of the six metrics that were selected as indicative of satisfaction were higher postintervention, including "staff attitudes toward visitors," "nurses kept you informed," "overall rating of nursing care," "included in decisions regarding treatment," "instructions for care at home," and "extent felt ready for discharge." The rate of HAIs dropped from 13.5 per 1000 patient days in 2008 to 6.25 per 1000 patient days in 2011.

Nursing Implications

The results from this quality improvement project support the continued study of family presence during dressing changes in burn units. Family presence during dressing changes could potentially diminish anxiety in the patient, which could mitigate the pain experienced by the patient. Furthermore, most patients with burns rely upon family members to aid with dressing changes once they are discharged to the home setting. Involving family members in the dressing change process earlier may facilitate their comfort in taking on this vitally important caretaking responsibility.

TABLE 47-4 Overview of Select Topical Antimicrobial Agents Used for Burn Wounds

Agent	Indication/Comment	Application	Nursing Implications
General			
Antimicrobial ointment	Antibacterial coverage and promotion of a moist wound environment	Apply 1/16-inch layer of ointment with a clean glove daily.	Ensure removal of old ointment at the time of wound cleaning prior to applying a new layer. Monitor closely for signs and symptoms of local infection.
Specific Agents			
Silver sulfadiazine 1% (Silvadene) water-soluble cream	Bactericidal agent for many gram-positive and gram-negative organisms, as well as yeast and *Candida albicans* Minimal penetration of eschar	Apply 1/16-inch layer of cream with a clean glove 1–3 times daily.	Anticipate formation of pseudo-eschar (proteinaceous gel), which can be removed.
Mafenide acetate 5%–10% (Sulfamylon) hydrophilic-based solution or cream	Antimicrobial agent for gram-positive and gram-negative organisms Diffuses through eschar and avascular tissue (e.g., cartilage)	Apply twice a day with a clean glove as prescribed.	Is a strong carbonic anhydrase inhibitor and may cause metabolic acidosis. Application may cause considerable pain initially.
Silver nitrate 0.5% aqueous solution	Effective against most strains of *Staphylococcus* and *Pseudomonas* and many gram-negative organisms. Does not penetrate eschar	Apply solution to gauze dressing and place over wound. Keep the dressing wet but covered with dry gauze and dry blankets to decrease vaporization.	Monitor serum sodium (Na^+) and potassium (K^+) levels, and replace as prescribed. Silver nitrate solution is hypotonic and acts as a wick for sodium and potassium. Protect bed linens and clothing from contact with silver nitrate, which stains everything it touches.
Silver-impregnated dressings (sheets or mesh)	Broad antimicrobial effects (product specific) Delivers a uniform, antimicrobial concentration of silver ions to the burn wound.	Apply directly to wound. Cover with absorbent secondary dressing if needed.	May produce a pseudo-eschar from silver after application. Can be left in place for several days (product specific).

Adapted from Micromedex 2.0. (2015). Formulary Advisor, University of Texas–Medical Branch Galveston. Retrieved on 7/10/2015 (pass-protected) at: www.micromedicsolutions.com/micromedex2/librarian

toes should be wrapped individually to promote mobility and function while healing.

Burns to the face may be left open to air once they have been cleaned and the topical agent has been applied. Careful attention is required to ensure that the topical agent does not come in contact with the eyes or mouth. A light dressing can be applied to the face to absorb excess exudates if needed.

Occlusive dressings, gauze, and a topical antimicrobial agent may be used over areas with new skin grafts to protect the new graft and promote an optimal condition for its adherence to the recipient site. Ideally, these surgical dressings remain in place for 3 to 5 days, at which time they are removed for examination of the graft. When occlusive dressings are applied, precautions are taken to prevent two body surfaces from touching, such as fingers or toes, ear and scalp, the areas under the breasts, any point of flexion, or between the genital folds. Functional body alignment positions are maintained by using splints or by regular repositioning of the patient.

Nursing Alert: Dressings can impede circulation if they are wrapped too tightly. The peripheral pulses must be checked frequently and burned extremities elevated. If the patient's pulse is diminished, this is a critical situation and must be addressed immediately.

Dressings that adhere to the wound bed may be removed more comfortably and with less damage to healing tissue by moistening the dressing with water. The patient may participate in removing the dressings, providing some degree of control over this painful procedure. The wounds are then cleaned and débrided to remove any remaining topical agent, exudate, and nonviable tissue. Sterile scissors and forceps may be used to trim loose eschar and encourage separation of devitalized tissue. During this procedure, the wound and surrounding skin are carefully inspected. Documentation should include color, odor, size, exudate, signs of re-epithelialization, any changes from the previous dressing change, and other key characteristics.

Vacuum Dressing

Vacuum dressing works by applying negative pressure by closed dressing system with the suction apparatus. It is applied in wounds with excessive exudates so that wound healing is facilitated (see Fig. 47-8). It also minimizes the sloughing and edema around the wound, and thereby increases the blood flow to the wound.

One disadvantage with negative-pressure application is that there is a huge loss of vitamins such as vitamins A, C, and E, and minerals such as copper and zinc. These elements are essential for wound healing. Hence, they need to be supplemented in higher proportion than in other wound treatment modalities (Hourigan, Omaye, Keen, et al., 2016).

Wound Débridement

The goals of débridement (the removal of *devitalized* tissue) are:

- Removal of devitalized tissue or burn eschar in preparation for grafting and wound healing
- Removal of tissue contaminated by bacteria and foreign bodies, thereby protecting the patient from invasion of bacteria

There are four types of débridement—natural, mechanical, chemical, and surgical.

Natural Débridement

With natural débridement, the devitalized tissue separates from the underlying viable tissue spontaneously. Bacteria present at the interface of the burned tissue and the viable tissue gradually liquefy the fibrils of collagen that hold the eschar in place. Collagen is a protein present in skin, tendon, bone, cartilage, and connective tissue. Proteolytic and other natural enzymes cause this phenomenon. The process may take weeks to months to occur.



Figure 47-8 • The vacuum dressing by creation of negative pressure in the wound dressing.

Mechanical Débridement

Mechanical débridement involves the use of surgical tools to separate and remove the eschar. This technique can be performed by physicians, specially trained nurses, or physical therapists and is usually done with daily dressing changes. If bleeding occurs, hemostatic agents or pressure can be applied to achieve hemostasis. Dressing changes and wound cleaning aid the removal of wound debris. Wet-to-dry dressings are not advocated in burn care because of the possibility of removing viable cells along with necrotic tissue.

Chemical Débridement

Topical enzymatic agents are available to promote débridement of burn wounds. Because such agents usually do not have antimicrobial properties, they may be used together with topical antibacterial therapy to protect the patient from bacterial invasion. Heavy metals such as silver can deactivate débriding agents; therefore, caution is necessary to ensure that the topical antimicrobial agent does not interfere with the chemical débridement. Alternating topical medications with dressing changes may also be considered.

Surgical Débridement

Early surgical excision to remove devitalized tissue along with early burn wound closure is now recognized as one of the most important factors contributing to survival in a patient with a major burn injury. Surgical débridement is carried out before the natural separation of eschar occurs. This may be performed as soon as possible after the burn, once the patient is hemodynamically stable and edema has decreased. Ideally, the wound is then covered immediately with a skin graft (if necessary) and a dressing. If the wound bed is not ready for a skin graft at the time of excision, a temporary biologic or

synthetic dressing may be used until a skin graft can be applied during a subsequent surgery.

The use of surgical excision carries with it risks and complications, especially with large burns. The procedure creates a high risk of extensive blood loss and lengthy operating and anesthesia times. Furthermore, blood losses sustained during surgical procedures, wound care, and ongoing hemolysis exacerbate anemia. Blood transfusions may be required periodically to maintain adequate hemoglobin levels for oxygen delivery to the myocardium. See Chapter 26 for discussion of blood component therapy.

When conducted in a timely and efficient manner, surgical excision results in shorter lengths of hospital stay and possibly a decreased risk of complications from invasive burn wound sepsis. Once débrided, granulation tissue fills the space created by the wound, creates a barrier to bacteria, and serves as a bed for epithelial cell growth. A wound covering is then applied to keep the wound bed moist and promote the granulation process.

Wound Grafting

The patient with deep partial- or full-thickness burns may be a candidate for skin grafting to decrease the risk of infection; prevent further loss of protein, fluid, and electrolytes through the wound; and minimize evaporative heat loss. Special attention is warranted when grafting the face (for cosmetic, functional, and psychological reasons); functional areas, such as the hands and feet; and areas that involve joints. Grafting permits earlier functional ability and reduces scar contractures (shrinkage of burn scar through collagen maturation). When burns are very extensive, the order in which areas are grafted is chosen based on the ability to achieve wound closure as soon as possible; therefore, the chest and abdomen or back may be grafted first to reduce the total body burn surface area.

Autografts

Autografting remains the preferred autologous method for definitive burn wound closure after excision. Autografts are the ideal means of covering burn wounds because the grafts are the patient's own skin and therefore are not rejected by the patient's immune system. They can be split-thickness, full-thickness, or epithelial grafts. Because the donor site (the area from which skin is taken to provide the autograft) for a full-thickness graft includes both the epidermis and dermis, its use must be cautiously considered because the donor site cannot heal spontaneously.

Split-thickness autografts are most commonly used and can be applied in sheets (see Fig. 47-9), or they can be expanded by meshing so that they cover more than a given donor site area (see Fig. 47-10). Skin meshers enable the surgeon to cut tiny slits into a sheet of donor skin, making it possible to expand to cover larger areas with smaller amounts of donor skin. These expanded grafts adhere to the recipient site more easily than sheet grafts and prevent the accumulation of blood, serum, air, or purulent material under the graft that would prevent revascularization and adherence. However, any kind of graft other than a sheet graft contributes to scar formation as it heals. The use of expanded grafts may be necessary in large wounds but should be viewed as a compromise in terms of cosmesis.

If blood, serum, air, fat, or necrotic tissue is present between the recipient site and the graft, there may be partial or total loss of the graft. Infection, mishandling of the graft, sheer injury



Figure 47-9 • Split-thickness sheet graft. Used with permission from University of Texas Medical Branch, Galveston, TX.



Figure 47-10 • Split-thickness meshed graft. Used with permission from University of Texas Medical Branch, Galveston, TX.

with mobilization or trauma during dressing changes account for most other instances of graft loss. The use of split-thickness grafts allows the remaining donor site to retain sweat glands and hair follicles, minimizing healing time.

Cultured epithelial autograft (CEA) has emerged as an important procedure in the management of massive burns. In burns that cover more than 90% TBSA, CEA may be the only option because the availability of nonburned skin as donor sites will not be sufficient for grafting. CEA involves obtaining full-thickness biopsies of the patient's unburned skin that are cultured to promote growth of keratinocytes. The final product is available approximately 3 weeks later for grafting (see Fig. 47-11). Meticulous attention is required to CEA applied to body surfaces because it is very fragile and prone to graft loss. Optimal application of CEA requires aggressive, early application of allograft to prepare and protect the wound bed (Kym, Yim, Yoon, et al., 2015). CEA can be cost prohibitive and requires extended LOS.

Care of the Graft Site Protection is key in caring for skin grafts postoperatively. Occlusive dressings are commonly used initially after grafting to immobilize the graft and support a

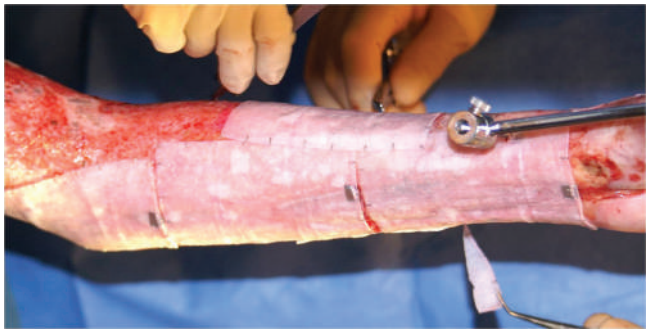


Figure 47-11 • Application of cultured epithelial autologous grafts. Used with permission from University of Texas Medical Branch, Galveston, TX.

humid environment. Occupational therapists may construct splints to immobilize newly grafted areas. Homograft, xenograft, or synthetic dressings (discussed later) may also be used to protect fragile grafts.

The first dressing change is usually performed 2 to 5 days after surgery, or earlier in the case of clinical signs of infection or bleeding. Infection, bleeding beneath the graft, and shearing forces are the most common reasons for graft loss in the early postoperative period. The patient is positioned and turned carefully to avoid disturbing the graft or putting pressure on the graft site. If an extremity has been grafted, it is elevated to minimize edema. The patient may begin exercising the grafted area 5 to 7 days after surgery. This may vary with individual burn center's protocols.

Care of the Donor Site The donor site is a clean wound created in a surgical environment. After the donor skin is excised, a hemostatic agent such as thrombin or epinephrine may be applied directly to the site to promote hemostasis. A myriad of dressings are available to cover donor sites. Donor sites must remain clean, dry, and free from pressure. Because a donor site is usually a partial-thickness wound, it is very painful and an additional potential site of infection. With proper care, the donor site should heal spontaneously within 7 to 14 days in a previously healthy, nonsmoking adult.

Homografts and Xenografts

Homografts (or allografts) and xenografts (or heterografts) are also referred to as biologic dressings and are intended as temporary wound coverage. Homografts are skin obtained from recently deceased or living humans other than the patient. Xenografts consist of skin taken from animals (usually pigs). Therefore, the body's immune response will eventually reject them as a foreign substance.

Biologic dressings protect the wound from physical trauma and loss of fluid, protein and heat; provide pain relief; and hasten re-epithelialization and, therefore, healing (Hermans, 2014). In extensive burns, they provide temporary wound coverage and protection of granulation tissue until autografting is possible. They may also be used as a test graft in preparation for autografting to determine if the bed will accept the graft. Once the biologic dressing appears to be "taking," or adhering to the granulating surface with minimal underlying exudation, the patient is ready for an autologous skin graft. As a temporary dressing, they also decrease the wound's evaporative water and protein loss, provide an effective barrier for entry of bacteria, and decrease pain by protecting nerve endings. Biologic dressings can be left open or covered. They stay in place for varying lengths of time but are removed in instances of infection or rejection. Another advantage of biologic dressings is that fewer dressing changes may be required.

Homografts tend to be the most expensive biologic dressings. They are available from skin banks in fresh and cryopreserved (frozen) forms. Homografts are thought to provide the best infection control of all biologic or biosynthetic dressings available. Revascularization occurs within 48 hours, and the graft may be left in place for several weeks.

Pigskin, an effective xenograft, is available from commercial suppliers. It is available fresh, frozen, or lyophilized (freeze-dried) for longer shelf life. Pigskin is used for temporary covering of clean wounds such as superficial partial-thickness wounds and donor sites. Although pigskin does not vascularize, it adheres to clean superficial wounds, providing pain control and reducing evaporative fluid loss while the underlying wound re-epithelializes (Lee, Dibildox, Jimenez, et al., 2012).

When grafting is not possible, skin substitutes have been created that surgically replace the epidermis and the dermis either temporarily or permanently. Each provides advantages and disadvantages that are important to consider in product selection.

Biosynthetic and Synthetic Dressings

Problems with availability, sterility, and cost have prompted the search for biosynthetic and synthetic dressings, which may eventually replace biologic dressings as temporary wound coverings. One widely used synthetic dressing is Biobrane® a dual-layer dressing of nylon and silicone (Jeschke, Finnerty, Shahrokhi, et al., 2013). The material is porous, semi-transparent, and sterile. It has an indefinite shelf life and is less costly than homograft or xenograft. Like biologic dressings, Biobrane® protects the wound from fluid loss and bacterial invasion and decreases pain at the site. It can remain in place until spontaneous re-epithelialization and wound healing occur, alleviating pain associated with frequent dressing changes. It can also be laid on top of a wide-meshed autograft to protect the wound until the autograft epithelium grows to close the interstices. As the Biobrane® gradually separates, it is trimmed away, leaving a healed wound (see Fig. 47-12).

Pain Management

A burn injury is considered one of the most painful types of trauma that a patient can experience. The nature of the injury



Figure 47-12 • Biobrane® applied to hand and forearm. Used with permission from University of Texas Medical Branch, Galveston, TX.

may expose nerve endings; and the patient may require multiple débridements, surgeries, and treatments. Moving, changing position, and receiving occupational and physical therapy cause additional discomfort. Adequate pain management must address background, procedural, and breakthrough pain.

Background pain is a continuous level of discomfort even when the patient is inactive or not undergoing any procedures. The goal of treatment is to provide a long-acting analgesic agent that will provide even coverage for this long-term discomfort. It is helpful to use escalating doses when initiating the medication to reach the level of pain control that is acceptable to the patient and facilitates participation in their recovery. The use of patient-controlled analgesia gives control to the patient and achieves this goal. Breakthrough pain is described as acute, intense, and episodic. It is generally related to an activity or movement of the affected area. Short-acting agents are used for breakthrough pain to achieve pain control if needed. Procedural pain is discomfort that occurs with procedures such as daily wound treatments, invasive line insertions, and physical and occupational therapy. The goal is to plan proper analgesia that will place the patient in a state of comfort throughout the procedure.

Most severe burns are a combination of partial- and full-thickness burns that influence the amount of pain the patient experiences. Superficial and partial-thickness burns are very painful because the nerve endings are not covered, resulting in excruciating pain with exposure to temperature, pressure, air currents, and movement. In a full-thickness burn, the nerve endings are destroyed, and upon admission there is numbness and decreased sensation to that area. Thus, the patient often underestimates severe injuries. Memories of the pain patients experience may persist for a long time. Educating patients and their families about burn pain and its relationship to the depth of injury as well as the pain management plan is an important priority for the nurse.

Pharmacologic treatment for the management of burn pain includes the use of opioids, nonsteroidal anti-inflammatory drugs, anxiolytics, and anesthetic agents. These and other pain management strategies are discussed in Chapter 9. Treatment of anxiety with benzodiazepines may be used along with opioids. The use of anesthetics in a nonoperative setting (i.e., moderate sedation) requires administration and monitoring by qualified personnel. Recent advances include the use of agents with rapid onset and short duration, which have been very effective in pain control during a planned procedure. In the provision of holistic patient care, the use of nonpharmacologic pain and anxiety interventions must not be overlooked. Nonpharmacologic therapies include relaxation techniques, distraction, guided imagery, hypnosis, therapeutic touch, humor, music therapy, and more recently virtual reality techniques.

Modulation of Hypermetabolism

Burn injuries produce profound metabolic abnormalities fueled by the exaggerated stress response to the injury. The body's response has been classified as hyperdynamic, hypermetabolic, and hypercatabolic. Hypermetabolism can affect morbidity and mortality by increasing the risk of infection and slowing the healing rate. Early nutritional support is essential to recovery for the patient with burns in order to attenuate the hypercatabolism and hypermetabolism that occurs (Abdullahi & Jeschke, 2014). Improvements in cellular defense, mucosal barrier function of the GI tract, and decreased inflammation have been seen with immune-modulating nutritional support (Sen et al., 2015).

Nutrition should be provided upon arrival to the burn center and may require placement of a feeding tube to deliver adequate calories. Patients who are critically ill may even have their feedings continued intraoperatively if the airway is protected. Several formulas exist for estimating the daily metabolic expenditure and caloric requirements of patients with burn injuries. Carbohydrates are the most important energy source and should account for 55% to 60% of nutrition delivery to decrease protein catabolism (Abdullahi & Jeschke, 2014). Fat, although a required nutrient, should be provided in more limited quantities. When the oral route is used, high-protein, high-calorie meals and supplements are given. Dietary consultations are useful in helping patients meet their nutritional needs. Daily calorie counts aid in assessing the adequacy of nutritional intake.

Early excision and grafting of the burn wound is one of the most important factors in ameliorating hypermetabolism by removing eschar, thereby lessening the effects of inflammatory mediators. Appropriate manipulation of environmental temperatures may decrease energy expenditure by the patient. Insulin therapy in patients with burns is needed to treat the hyperglycemia that occurs from accelerated gluconeogenesis and is beneficial in muscle protein synthesis. Oxandrolone (Oxandrin), an anabolic steroid, is commonly given to patients with burns because it improves protein synthesis and metabolism. Administration of propranolol (Inderal) (a beta-blocker) decreases heart rate and blocks harmful catecholamine effects. Lastly, exercise is described as an essential adjunct in the plan of care for patients with burns, because it attenuates the hypermetabolic response and increases lean muscle mass (Abdullahi & Jeschke, 2014).

Nursing Management

Nursing management of the patient in the acute/intermediate phase is focused on the following priorities: restoring fluid balance, preventing infection, modulating hypermetabolism, promoting skin integrity, relieving pain and discomfort, promoting mobility, strengthening coping strategies, supporting patient and family processes, and monitoring and managing complications.

Restoring Normal Fluid Balance

To reduce the risk of fluid overload and consequent heart failure and pulmonary edema, daily weights and careful calculation of intake and output measurement are utilized to guide therapy. Changes in physical assessment and hemodynamic indicators are also useful in evaluating the patient's response to treatment.

Preventing Infection

The patient with burns is at risk for infection from multiple sources, which may include open wounds, lung injury, GI ischemia, and indwelling catheters. Therapeutic interventions are complex due to the patient's altered physiology. Signs of infection including increased temperature, tachycardia, tachypnea, and leukocytosis may be present in the patient with burns without underlying infection, making infections more difficult to recognize.

A major part of the nurse's role during the acute phase of burn care is detection and prevention of infection. The nurse is responsible for providing a clean environment, including the promotion of protective isolation interventions. The nurse protects the patient from sources of contamination, including other patients, staff members, visitors, and equipment. Patients can inadvertently promote migration of microorganisms from one burned area to another by touching their wounds or dressings. Bed linens can also spread infection through either colonization with wound microorganisms or fecal

contamination. Regular bathing of unburned areas and changing of linens can help prevent infection. Fresh flowers, plants, and fresh fruit baskets are not permitted in the patient's room because of the risk of microorganism growth. Invasive lines and tubing must be routinely changed according to CDC recommendations, and prompt removal of all indwelling catheters when no longer indicated can prevent HAIs.

Modulating Hypermetabolism

The nurse collaborates with the dietitian or nutrition support team to develop a plan that meets the needs of the patient. Family members may be encouraged to bring nutritious and favorite foods to the hospital. High-calorie nutritional supplements may be necessary. Nutritional intake must be accurately documented. Vitamin and mineral supplements may be prescribed.

If caloric goals cannot be met by oral feeding, a feeding tube is inserted and used for continuous or bolus feedings of specific formulas. The volume of residual gastric secretions should be checked to ensure absorption. The patient should be weighed each day and the results tracked to properly assess appropriate weight parameters and to attenuate catabolism of lean muscle mass.

Promoting Skin Integrity

Wound care is usually the single most time-consuming element of burn care after the emergent phase. The primary provider prescribes the desired topical antibacterial agents and specific biologic, biosynthetic, or synthetic wound coverings and plans for surgical excision and grafting. The nurse needs to make astute assessments of wound status, use creative approaches to wound dressings, and support the patient during the emotionally distressing and significantly painful experience of wound care.

Assessment of the burn wound requires an experienced eye, hand, and sense of smell. Important wound assessment features include size, color, odor, presence of eschar and exudate, epithelial buds (small pearl-like clusters of cells on the wound surface), bleeding, granulation tissue, the status of graft take, healing of the donor site, and the condition of the surrounding skin. Any significant changes in the wound are reported to the primary provider because they may indicate burn wound infection and require immediate intervention.

The nurse also assists the patient and family by providing instruction, support, and encouragement to take an active part in dressing changes and wound care when appropriate. Discharge planning needs for wound care must be anticipated early in the course of burn management, and the strengths of the patient and family are assessed and used in preparing for the patient's eventual discharge and home care needs. Family presence during dressing changes promotes feelings of readiness for discharge (see Chart 47-7) (Bishop et al., 2013).

Relieving Pain and Discomfort

Pain management continues to be a priority during the acute phase of burn recovery. Frequent assessment of pain is required, and analgesic and anxiolytic medications are given as prescribed. To increase its effectiveness, analgesic medication is provided before the pain becomes severe. Nonpharmacologic interventions can be used to alter the patient's perceptions of and responses to pain. Frequent reassessment of responses to interventions, whether pharmacologic or nonpharmacologic, is essential.

Post-burn pruritus (itching) affects almost all patients with burns and is one of the most distressing symptoms in the post-burn period. Oral antipruritic agents, environmental conditions, frequent lubrication of the skin with water or silica-based lotion, and diversion activities all help to promote comfort in this phase. The instructions "pat, don't scratch" must be reinforced with patients in order to prevent further discomfort and infectious complications. Although gabapentin (Neurontin) had been prescribed to treat both pain and pruritus in patients' post burns, results from a recent double-blinded, randomized controlled trial does not support its effectiveness (Wibbenmeyer, Eid, Liao, et al., 2014).

Lack of sleep and rest interfere with healing, comfort, and restoration of energy. If necessary, sleep aids are prescribed on a regular basis in addition to analgesic and anxiolytic agents.

Promoting Physical Mobility

An early priority is to prevent complications of immobility. Deep breathing, turning, and proper positioning are essential nursing practices that prevent atelectasis and pneumonia, control edema, and prevent pressure ulcers and contractures. Specialty beds may be useful, and early mobility is strongly encouraged. If the lower extremities are burned, elastic pressure bandages should be applied before the patient is placed in an upright position to promote venous return and minimize edema formation. A review of over 36,000 patients with burns showed a DVT rate of 0.8%. Risk factors that were identified included a TBSA greater than 20%, previous history of DVT, African American race, and use of blood transfusions and mechanical ventilation (Satahoo, Parikh, Naranjo, et al., 2015).

The burn wound is in a dynamic state for at least 1 year after wound closure. During this time, aggressive efforts must be made to prevent contracture and hypertrophic scarring. Both passive and active range-of-motion exercises are initiated from the day of admission and are continued after grafting within prescribed limitations. Splints or functional devices may be applied to the extremities for contracture control. The nurse monitors the splinted areas for signs of vascular insufficiency, nerve compression, and skin breakdown. Occupational and physical therapists are consulted to develop a patient-specific plan of care throughout hospitalization and recovery.

Strengthening Coping Strategies

Much of the patient's energy goes into maintaining vital physical functions and wound healing in the early post-burn weeks, leaving little emotional energy for coping. In the acute phase of burn care, the patient is facing the reality of the burn injury. Grief, depression, anger, regression, and manipulative behavior are common responses of patients who have burn injuries. Withdrawal from participation in required treatments and regression must be viewed with an understanding that such behavior may help the patient cope with an enormously stressful event.

The patient may experience feelings of anger. At times, the anger may be directed inward because of a sense of guilt, perhaps for causing the fire or even for surviving when others perished. The anger may also be directed outward toward those who escaped unharmed or those who are now providing care. One way to help the patient handle these emotions is to enlist someone to whom the patient can express feelings without fear of retaliation. A nurse, social worker, psychiatric liaison nurse, peer supporter or counselor who is not involved in direct care activities may fill this role successfully.

Patients with burn injuries are very dependent on health care team members during the long period of treatment and recovery. However, even when physically unable to contribute much to self-care, they should be included in decisions regarding care and encouraged to assert their individuality in terms of preferences and recognition of their unique identities.

As the patient improves in mobility and strength, the nurse works with the patient to set realistic expectations for self-care and planning for the future. Many patients respond positively to the use of contractual agreements and other strategies that recognize their independence, set expectations for behavior, and encourage positive communication.

Supporting Patient and Family Processes

The burn injury has tremendous psychological, economic, and life-altering impact on the patient and family. The nurse is instrumental in providing support to the patient and family as they adapt to the burn injury. Referrals for social services or psychological counseling should be made as appropriate. This support continues into the rehabilitation phase. Some burn centers offer a structured peer support program in which a patient who has survived a burn injury visits the patient while hospitalized to provide psychosocial support. Many patients appreciate the opportunity to be able to share their experience with another person who has had a burn injury.

Patients who experience major burns are commonly sent to burn centers far from home. Because burn injuries are sudden and unexpected, family roles are disrupted. If the primary caregiver or wage earner in the family is injured, roles may change, which adds more stress to the family. Therefore, both the patient and the family need thorough information regarding the patient's burn care and expected course of treatment. Barriers to learning and preferred learning styles are assessed and considered. This information is used to tailor education activities. Patient and family education is a priority and is best provided with a multimedia approach.

Monitoring and Managing Potential Complications

Acute Respiratory Failure and Acute Respiratory Distress Syndrome

The patient's respiratory status is monitored closely for increased difficulty in breathing, change in respiratory pattern, or onset of adventitious (abnormal) breath sounds. Typically, at this stage, signs and symptoms of injury to the respiratory tract become apparent. As described previously, signs of hypoxia, diminished breath sounds, wheezing, tachypnea, stridor, and sputum tinged with soot (or in some cases containing sloughed tracheal tissue) are among the many possible findings. Medical management of the patient with acute respiratory failure requires intubation and mechanical ventilation (if not already in use). If ARDS has developed, higher oxygen levels, positive end-expiratory pressure, and pressure support are used with mechanical ventilation to promote gas exchange across the alveolar–capillary membrane (see Chapters 11 and 12).

Heart Failure and Pulmonary Edema

If the cardiac and renal systems cannot compensate for the excess vascular volume as fluid shifts back to the intravascular space, heart failure and pulmonary edema may result. The patient is assessed for signs of heart failure, including decreased cardiac output, oliguria, jugular vein distention, persistent edema, and the onset of an S_3 or S_4 heart sound. If invasive hemodynamic monitoring is used, increasing central venous, pulmonary artery, and pulmonary artery wedge pressures indicate increased fluid volume.

Crackles in the lungs and increased difficulty with breathing may indicate pulmonary edema, which should be reported promptly to the primary provider. In the meantime, the patient is positioned comfortably, with the head of the bed raised (if not contraindicated by other treatments or injuries) to promote lung expansion and gas exchange. Management of this complication includes providing supplemental oxygen, administering IV diuretic agents, carefully assessing the patient's response, and providing vasoactive medications, if indicated (see Chapter 23).

Sepsis

Sepsis is a leading cause of morbidity and mortality in patients with burn injuries. The signs of early sepsis are subtle and require a high index of suspicion and very close monitoring of changes in the patient's status. One of the challenges in the recognition of sepsis is the lack of definition of sepsis in the population of patients with burns. Because patients with burns are hypermetabolic, this results in tachycardia, tachypnea, and elevated body temperature. These physiologic norms in patients with burns make the diagnosis of sepsis more challenging. A recent retrospective study of burn admissions over a 5-year period found that temperature less than 36°C (96.8°F), heart rate greater than 130 bpm, base deficit less than −6 mEq/L, a mean arterial pressure less than 60 mm Hg, serum glucose greater than 150 mg/dL, and utilization of vasopressors were predictive of sepsis in patients with burns (Mann-Salinas, Baun, Meininger, et al., 2013). See Chapter 8 for treatment recommendations for sepsis.

Rehabilitation Phase

Rehabilitation begins immediately after the burn has occurred and often extends for years after the initial injury. For nurses who care for patients with burns, this can be one of the more physically demanding and challenging phases. One important focus of the burn team is to evaluate the patient carefully for late complications related to burn injuries as described in Table 47-5.

Burn rehabilitation is comprehensive, complex, and requires a multidisciplinary approach to optimize the patient's physical and psychosocial recovery related to the injury. As patients begin to recover, they become more aware of the injuries and the challenges they face. Individualized plans of care that are specific to the severity and location of injury are developed and reevaluated frequently. The increased survival of patients with significant burn injuries has translated into the need for additional and comprehensive burn rehabilitation programs worldwide. The ultimate goal is to return patients to the highest level of function possible within the context of their injuries. Occupational and physical therapists are essential to optimize patient goals and outcomes.

Psychological Support

A patient's outlook, motivation, and support system are important to their overall well-being and ability to progress through the rehabilitation phase. Psychiatric disorders may have contributed to the cause of the burn injury itself. Examples include self-inflicted burns, suicide attempts, or intentional infliction on one individual by another in cases of abuse. These are a few examples that illustrate the critical need for psychosocial resources in burn recovery. Although psychiatric disorders are not contributory to all burn injuries, the life-altering nature of burn injuries almost always causes temporary or permanent impairment of psychosocial adaptation.

In the acute phase of the injury, acute shock, terror, disbelief, confusion, and anxiety are common. Patients may be at risk for delirium and may experience temporary psychoses. Patients may be confused from medications they are taking, but they have an underlying sense of fear, anxiety, and pain. Early consultation with mental health professionals will assist to best meet individual needs, which may include pharmaceutical interventions with concurrent counseling.

TABLE 47-5 Complications in Rehabilitation Phase of Burn Care

Complications	Contributing Factors	Interventions
Neuropathies and nerve entrapment	Electrical injury, large deep burns, improper positioning, edema, scar tissue	Assess peripheral pulses and sensation (neurovascular checks). Prevent edema and pressure by elevation, positioning, and prevention of constricting dressings. Assess splints for proper fit and application. Consult OT and PT departments for positioning.
Wound breakdown and/or pressure ulcer formation	Shearing, pressure, inadequate nutrition	Protect wound from pressure and shearing forces. Educate patient about importance of good nutrition.
Hypertrophic scarring	Partial- and full-thickness burns	Keep skin pliable and soft by using emollients. Apply pressure garments as prescribed. Massage.
Contractures	Partial- and full-thickness burns	Maintain position of joints in alignment. Perform gentle range-of-motion exercises. Consult OT and PT departments for exercises and positioning recommendations.
Joint instability	Burn wound, burn scar, and contractures	Maintain appropriate joint positioning through appropriate application of splints. Monitor joint pinning if indicated.
Complex pain	Trauma and burns	Provide adequate pain management. Consult OT and PT departments for exercises and desensitization. Promote gentle motion of affected extremities.

OT, occupational therapy; PT, physical therapy.

The rehabilitation phase may present a new set of challenges. While the patient is physically recovering, the reality and impact of the injury begin to set in as patients recognize that survival is expected. Patients may experience devastating grief and loss. The sense of loss may originate from physical injury, loss of control from the forced dependency on others for care, or loss of family members/friends who may have perished in the injury. In residential fires, survivors may have lost their homes and all of their possessions.

Posttraumatic stress disorder (PTSD) is the most common psychiatric disorder in patients with burns, with a prevalence of 8% to 30% (Hobbs, 2014). Other psychological disorders that may be experienced by patients with burns include anxiety, depression, and sleep disturbances.

As recovery progresses, discharge planning must include strategies to assist the patient in reintegrating into their home, community, workplace, and school. For many patients, issues regarding quality of life may become very real at this point in recovery. This is an emotional time as the patient and family begin to live with new physical limitations and challenges in relationships. In addition to preparing the patient's support system, the patient and family must also prepare for the reactions from strangers.

Organizations that provide support for reintegration are able to offer education and training geared specifically to patients with burn injuries. Workshops on application of makeup to reduce the appearance of scars can benefit those with obvious facial scarring is just one example of strategies available to assist patients with burns who have body image disturbances. Cultural influences play a strong factor in this process, because some cultures are particularly sensitive to physical appearance, which is reinforced by current media. The role of the nurse is to encourage patients to voice their concerns, provide empathy, and provide them with assistive resources.

Abnormal Wound Healing

Partial-thickness wounds involving the epidermis and superficial dermis tend to heal without scarring. Deeper wounds will likely develop scarring of variable degrees. As with other disorders, risk factors may be stratified as modifiable or nonmodifiable. For example, a nonmodifiable risk factor for scarring is heredity, because some patients are simply more prone to hypertrophic scar formation. The focus of patient education for nurses must be on how to best change or adapt risk factors that are modifiable. Patients should be strongly encouraged to follow occupational therapist recommendations for scar prevention and management.

Normal scarring occurs in a superficial tissue injury and begins forming within 7 to 10 days post-injury and progresses over the next 6 to 12 months. Abnormal scarring occurs after a longer period of wound healing and may form either hypertrophic or keloid scars.

Hypertrophic and Keloid Scars

Hypertrophic scars form within the boundaries of the initial wound and push outward on the perimeter of the wound. They are common in areas over joints and in the younger population. The scar becomes red (because of its hypervascular nature), raised, and hard.

Keloid scars are irregularly formed and extend beyond the margins of the original wound. They are large, nodular, and ropelike, often causing itching and tenderness. They are more common in dark-pigmented skin, uncommon in children and older adults, and have familial tendencies.

Prevention and Treatment of Scars

Preventive treatment modalities are used to prevent scar contractures and excess hypertrophic tissue. Compression is introduced early in burn wound treatment. Elastic bandage wraps are used initially to help promote adequate circulation, but they can also be used as the first form of compression for scar management, followed by elasticized tubular bandages until the patient can be measured for a customized garment. Application of elastic pressure garments loosens collagen bundles and encourages parallel orientation of the collagen to the skin surface. As pressure continues over time, collagen

restructures and vascularity decreases. Although this therapy is somewhat controversial, pressure has shown to be beneficial in controlling scar formation over time. Garments are worn continuously (i.e., 23 hours per day).

Many areas of the body are difficult to compress due to the contours or location of the injury. Inserts, such as silicone sheets, are helpful for these small troublesome areas and are placed beneath the garment or compression dressing to enhance scar compression. Gentle superficial scar massage can be performed with a moisturizer several times a day.

Burn reconstruction is a treatment option after scars have matured and is discussed within the first few years after injury. This decision requires individualized planning, realistic expectations, and patience. The treatment team and the patient will ultimately decide on the best approach for long-term functionality and cosmesis.

NURSING PROCESS

Care of the Patient During the Rehabilitation Phase

Assessment

The nurse obtains information about the patient's education level, occupation, leisure activities, cultural background, religion, and family interactions. The patient's self-concept, mental status, emotional response to the injury and subsequent hospitalization, level of intellectual functioning, previous hospitalizations, response to pain and pain relief measures, and sleep pattern are also essential components of a comprehensive assessment. Information about the patient's general self-concept, self-esteem, and coping strategies in the past are valuable in assessing emotional needs.

Ongoing physical assessments related to rehabilitation goals include range of motion of affected joints, functional abilities in ADLs, early signs of skin breakdown, evidence of neuropathies (nerve damage), activity tolerance, and quality or condition of healing skin. The patient's participation in care and ability to demonstrate self-care in such areas as ambulation, eating, wound cleaning, toileting, and applying pressure wraps are documented on a regular basis.

Diagnosis

Nursing Diagnoses

Based on the assessment data, nursing diagnoses may include the following:

- Activity intolerance related to pain with exercise, limited joint mobility, muscle wasting, and limited endurance
- Disturbed body image related to altered physical appearance and self-concept
- Impaired physical mobility due to contractures or hypertrophic scarring
- Deficient knowledge about postdischarge home care and recovery needs

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Inadequate psychological adaptation to burn injury

Planning and Goals

The major goals for the patient include increased mobility and participation in ADLs; adaptation and adjustment to alterations in body image, self-concept, and lifestyle; increased understanding and knowledge of the injury, treatment, and planned follow-up care; and absence of complications.

Nursing Interventions

Promoting Activity Tolerance

The extensive physical rehabilitation can be painful and acute for the patient. Strategies to maintain motivation and participation may be beneficial during this critical phase. The nurse incorporates physical and occupational therapy exercises in the patient's care to prevent muscle atrophy and to maintain the mobility required for daily activities. The patient's activity tolerance, strength, and endurance gradually increase if activity occurs over increasingly longer periods. Fatigue and pain tolerance are monitored and used to determine the amount of activity to be encouraged on a daily basis. Activities such as family visits and recreational therapy (e.g., video games, radio, television) can provide diversion, improve the patient's outlook, and increase tolerance for physical activity. In older adult patients and those with chronic illnesses and disabilities, rehabilitation must take into account preexisting functional abilities and limitations.

The nurse must schedule care in such a way that the patient has periods of rest and uninterrupted sleep. A good time for planned patient rest is after the stress of dressing changes and exercise, while pain interventions and sedatives are still effective. This plan must be communicated to family members and other care providers. The patient may have insomnia related to frequent nightmares about the burn injury or other fears and anxieties about the outcome of the injury. The nurse reassures the patient and administers agents, as prescribed, to promote sleep. Reducing metabolic stress by relieving pain, preventing chilling or fever, and promoting the physical integrity of all body systems help the patient conserve energy for therapeutic activities and wound healing.

Improving Body Image and Self-Concept

Patients who have survived burn injuries may lack the benefit of anticipatory grief often seen in a patient who is approaching surgery or dealing with the terminal illness of a loved one. As care progresses, the patient who is recovering from burns becomes aware of daily improvement and begins to exhibit basic concerns: Will I be disfigured or be disabled? How long will I be in the hospital? What about my job and family? Will I ever be independent again? How will this injury affect my sexual relationships? How can I pay for my care? Was my burn the result of my carelessness? Where will I live now?

When caring for a patient with a burn injury, the nurse needs to be aware that there are prejudices and misunderstandings in society about those who are viewed as different. Opportunities and accommodations available to others are often denied to those who are disfigured by scarring associated with burn injury. These include social participation, employment, prestige, various roles, and status. The health care team must actively promote a healthy body image and self-concept in patients with burn injuries so that they can accept or challenge others' perceptions of those who are disfigured or disabled. Survivors themselves must show others who they are, how they function, and how they want to be treated.

Promoting Physical Mobility Through Preventing Contractures or Hypertrophic Scar Formation

With early and aggressive physical and occupational therapy, contractures or hypertrophic scars are rarely a long-term complication. However, surgical intervention is indicated if full range of motion in the patient with burns is not achieved. See Chapter 38 for a discussion of range of motion exercises. Range of

motion exercises need to be started as early as possible following burn injury for prevention of contractures and deformities.

Monitoring and Managing Potential Complications

Impaired Psychological Adaptation to the Burn Injury. Some patients, particularly those with limited coping skills or psychological function, or a history of psychiatric problems before the burn injury, may not achieve adequate psychological adaptation to the burn injury. Psychological counseling or psychiatric referral may be made to assess the patient's emotional status, to help the patient develop coping skills, and to intervene if major psychological issues or ineffective coping is identified.

Promoting Home, Community-Based, and Transitional Care

Educating the Patient about Self-Care. The focus of rehabilitative interventions is directed toward outpatient care, home care, or care in a rehabilitation center. This includes wound care, dressing changes, pain management, nutrition, prevention of complications, and other care needs. Information and written instructions are provided about specific exercises and the use of pressure garments and splints. The patient and family are provided education to assist them in their continued care needs after discharge (see Chart 47-8).

Chart 47-8 HOME CARE CHECKLIST

The Patient with a Burn Injury

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of the burn injury and treatment on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State how to contact all members of the treatment team (e.g., interdisciplinary burn team, health care providers, home care professionals, and durable medical equipment and supply vendor).
- State the name, dose, side effects, frequency, and schedule for all medications.
- Demonstrate psychosocial adaptation and social integration through verbalizing understanding of the following:
  - Changes in lifestyle and emotional adjustment to injury take time. It is not uncommon for patients to report nightmares or "flashbacks" of the injury. If this becomes disruptive, it should be discussed with the treatment team.
  - Resume previous interests and activities gradually.
  - Burn care such as dressing, medicines, and treatment is very expensive; therefore, it is advised to contact some NGO or good samaritan for financial help.
- Demonstrate adaptation of the home environment, assisted as needed by team members.
- State burn skin precautions:
  - Wear sunblock with the highest sun protection factor (SPF) possible to protect exposed burned skin from the sun. Light-colored clothing, long pants, and long-sleeved shirts may also be necessary to protect from the sun.
  - Wear wide-brimmed hats if face or ears have been burned to protect the area from the sun.
  - Avoid further trauma to burned skin; leave blisters that may form intact.
  - Lubricate healed burned skin with mild lotion (as prescribed); avoid scratching.
  - Use only mild soap and lotion (i.e., products without perfume) on burned areas. Keeping skin clean overall is important to support good hygiene and prevent infection.
  - Avoid tight clothing over burned areas so as not to restrict movement or irritate newly healed areas.
  - Select white cotton, loose-fitting clothing so that dyes in colored clothes do not irritate healing skin.
  - Wear clothing and gloves to protect healing skin from unnecessary bruises, bumps, and scratches.
  - Be aware that tolerance to extremes in temperatures may be affected.
  - Itching is a normal, uncomfortable part of healing and burn recovery; do not scratch, pat areas; apply mild moisturizers to decrease itching from dryness. Medications for itching can be discussed with the treatment team.
- Demonstrate wound care technique:
  - Take prescribed pain medications if needed 30 min prior to wound care to achieve maximum effectiveness.
  - Use mild soap, water, and a clean washcloth to clean wounds.
  - Apply prescribed topical medications and dressings as instructed.
  - Inspect wounds carefully with each dressing change for signs of infection, including increased redness, swelling, drainage, or foul odor.
- State aspects of ADLs and exercise:
  - Perform as much of own care as possible.
  - Adhere to the exercise regimen given by the therapists.
  - Although physical rehabilitation is tiring, daily participation is essential.
  - Plan for adequate rest and sleep.
  - When at rest, swollen limbs should be elevated.
- Describe approaches to controlling pain (e.g., take analgesics as prescribed; use nonpharmacologic interventions).
- States changes in diet necessary to promote health (e.g., nutrient rich foods, rather than empty calories).
- States changes in fluid intake needed to prevent constipation associated with the use of analgesic medications.
- Discusses management of burn scar:
  - Massage with mild lotion or cream to stretch skin to maintain/increase its elasticity.
  - Wear compression garments 23 hours a day if instructed.
  - Discoloration of the skin for many months is an expected normal part of healing.
- Discuses resumption of sexual relations:
  - Resumption of sexual relationships is the rule rather than the exception and should occur when comfortable for all.
  - Expect sensitivity of and around the genital area for several months if these areas were burned.
- States correct use of medical devices:
  - Follow occupational therapist's instructions for splint use and cleaning.
  - Use crutches, walkers, or other assistive devices as instructed.
  - If devices such as shower chairs or grab bars are needed in the home, this should be arranged prior to discharge.
- State time and date of follow-up appointments, therapy, and testing:
  - Keep a list of questions to ask team members.
  - Bring medications, or a list of current medications, to each visit for the team to review.
- Identify sources of support (e.g. friends, relatives, faith community, burn support groups, and caregiver support).
- Identify the need for health promotion, disease prevention, and screening activities.

ADL, activities of daily living; IADL, independent activities of daily living.

Continuing and Transitional Care. After discharge, care by a multidisciplinary treatment team is necessary. Some patients may require the services of an inpatient rehabilitation center before returning home. Patients should receive follow-up from a burn center when possible for periodic evaluation by the burn team, modification of outpatient treatment plan, and evaluation for reconstructive surgery. Many patients require outpatient physical or occupational therapy several times a week. The nurse coordinates all aspects of care and ensures that the patient's needs are met. Such coordination is an important aspect of assisting the patient to achieve independence.

Some patients may require referral for transitional care after discharge. The nurse assesses the patient's physical and psychological status as well as the adequacy of the home setting for safe and adequate care. The nurse monitors the patient's progress; assesses adherence to the plan of care; and assists the patient and family with wound care, exercises, and other physical needs. Patients experiencing difficulties with psychosocial adjustments are identified and appropriate referrals are made.

Evaluation

Expected patient outcomes may include:

1. Demonstrates adequate activity tolerance
   a. Has energy available to perform daily activities
   b. Shows gradual increased tolerance and endurance in physical activities
   c. Obtains adequate sleep and rest daily
2. Adapts to altered body image
   a. Verbalizes accurate description of alterations in body image and accepts physical appearance
   b. Demonstrates interest in resources that may improve function and perception of body appearance (e.g., cosmetics, wigs, and prostheses as appropriate)
   c. Socializes with significant others, peers, and usual social group
   d. Seeks and achieves return to role in family, school, and community as a contributing member
3. Demonstrates physical mobility adequate to perform ADLs
   a. Demonstrates range of motion appropriate for injury
   b. Absence of complications from wound healing
4. Demonstrates knowledge of required self-care and follow-up care
   a. Verbalizes detailed plan for follow-up care
   b. Demonstrates ability to perform or direct wound care and prescribed exercises
   c. Returns for follow-up appointments as scheduled
   d. Identifies resource people and agencies to contact for specific problems
5. Exhibits no complications
   a. Exhibits psychosocial adaptation to burn injury
   b. Verbalizes understanding of diagnosis and treatment plan

Outpatient Burn Care

The increased availability of outpatient surgery and access to expert burn care in outpatient settings make this option possible for the treatment of minor burns as well as follow-up for the patient with more severe burns who is discharged. The goals for treatment in an outpatient setting may include burn wound management, pain management, scar and reconstructive care, psychosocial care, and rehabilitation. However, a number of factors must be considered when determining if outpatient care is appropriate for the patient: age, past medical history, extent and depth of the burn, location of the burn wounds, availability of family support systems and community resources, the patient's ability and willingness to adhere to a therapeutic regimen, distance from home, and availability of transportation from home to the outpatient setting.

The frequency of follow-up visits is individualized. The initial outpatient visit for a discharged patient with burn injuries is usually scheduled within 2 to 3 days after hospital discharge. Follow-up appointments will vary and over time decrease in frequency, based on the patient's needs. Patient and family education is paramount and should include verbal and written instructions as well as return demonstration of the wound or scar care required. The importance of notifying the outpatient setting about early complications and of keeping follow-up appointments is emphasized to the patient and family. Physical therapy and occupational therapy are often provided in the outpatient burn setting. The rehabilitation goals are to increase range of motion, strengthen muscles, and build the patient's activity tolerance. This is accomplished by a specific plan of care and includes routine visits for up to 2 years or more following the injury.

Adaptation to lifestyle changes and emotional status should be assessed during the outpatient visits and proper referrals made for counseling services. These assessments may be difficult to recognize due to the infrequent nature of the visits; therefore, it is helpful to incorporate family response and interactions into the assessment. The health care team must also be alert to issues of substance abuse, safety concerns, suicidal thoughts, depression, and PTSD.

PLASTIC, RECONSTRUCTIVE, AND COSMETIC PROCEDURES

The word plastic comes from a Greek word meaning "to form." Plastic or reconstructive procedures are performed to reconstruct or alter congenital or acquired defects to restore or improve the body's form and function. Often the terms plastic and reconstructive are used interchangeably. This type of surgery includes closure of wounds, removal of skin tumors, repair of soft tissue injuries or burns, correction of deformities, and repair of cosmetic defects. Plastic surgery can be used to repair many parts of the body and numerous structures, such as bone, cartilage, fat, fascia, mucous membrane, muscle, nerve, and cutaneous structures. Bone inlays and transplants for deformities and nonunion can be performed, muscle can be transferred, nerves can be reconstructed and spliced, and cartilage can be replaced. As important as any of these measures is the reconstruction of the cutaneous tissues around the neck and the face; this is usually referred to as *aesthetic* or *cosmetic surgery*.

Cosmetic procedures are generally considered to be ones that correct defects that are not life threatening or caused by disease. An example would be removal of a benign mole or sebaceous cyst from the face. Most health insurance plans do not cover procedures deemed to be cosmetic, and these procedures can be expensive. Procedures that are performed to correct a surgical defect, such as removal of a skin cancer or correction of a significant congenital defect such as a cleft lip, are generally covered by insurance.

Wound Coverage: Grafts and Flaps

Various surgical techniques, including skin grafts and flaps, are used to cover skin wounds.

Skin Grafts

Skin grafting is a technique in which a section of skin is detached from its own blood supply and transferred as free tissue to a distant (recipient) site. Skin grafting can be used to repair almost any type of wound and is the most common form of reconstructive surgery.

Skin grafts are commonly used to repair surgical defects such as those that result from excision of skin tumors, to cover areas denuded of skin (e.g., burns), and to cover wounds in which insufficient skin is available to permit wound closure. They are also used when primary closure of the wound increases the risk of complications or when primary wound closure would interfere with function.

Skin grafts types, selection, and nursing management are detailed in the earlier part of this chapter on burn wound management.

Grafts are also referred to by their thickness. A skin graft may be a split-thickness (i.e., thin, intermediate, or thick) or a full-thickness graft, depending on the amount of dermis included in the specimen. A split-thickness graft can be cut at various thicknesses and is commonly used to cover large wounds or defects for which a full-thickness graft or flap is impractical (see Fig. 47-13). A full-thickness graft consists of epidermis and the entire dermis without the underlying fat. It is used to cover wounds that are too large to be closed directly (Urden, Stacy, & Lough, 2014).

Flaps

Another form of wound coverage is provided by flaps. A flap is a segment of tissue that remains attached at one end (i.e., a base or pedicle) while the other end is moved to a recipient area. Its survival depends on functioning arterial and venous blood supplies and lymphatic drainage in its pedicle or base (Clark, Wang, & Terris, 2015). A flap differs from a graft in that a portion of the tissue is attached to its original site and retains its blood supply. An exception is the free flap, which is described later.

Flaps may consist of skin, mucosa, muscle, adipose tissue, omentum, and bone. They are used for wound coverage and provide bulk, especially when bone, tendon, blood vessels, or nerve tissue is exposed. Flaps are used to repair defects caused by congenital deformity, trauma, or tumor ablation (removal, usually by excision) in an adjacent part of the body (Clark et al., 2015).

Flaps offer an aesthetic solution because a flap retains the color and texture of the donor area; is more likely to survive than a graft; and can be used to cover nerves, tendons, and blood vessels. However, several surgical procedures are usually required to advance a flap. The major complication is necrosis of the pedicle or base as a result of failure of the blood supply.

A striking advance in reconstructive surgery is the use of free flaps or free tissue transfer achieved by microvascular techniques. A free flap is completely severed from the body and transferred to another site. A free flap receives early vascular supply from microvascular anastomosis with vessels at the recipient site. The procedure usually is completed in one step, eliminating the need for a series of surgical procedures to move the flap. Microvascular surgery allows surgeons to use a variety of donor sites for tissue reconstruction (Clark et al., 2015).

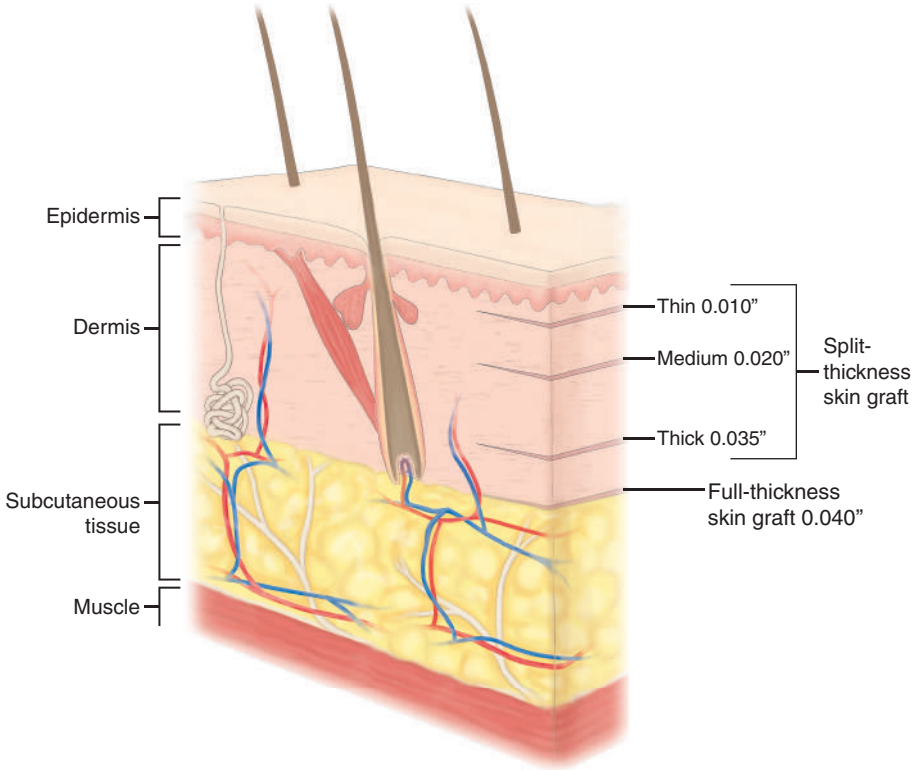


Figure 47-13 • Layers of skin appropriate for split and full thickness graft.

Cosmetic Procedures

Chemical Face Peeling

Chemical face peeling involves application of a chemical mixture to the face for superficial destruction of the epidermis and the upper layers of the dermis to treat fine wrinkles, keratoses, and pigment problems. It is especially useful for wrinkles at the upper and lower lip, forehead, and periorbital areas. The type of chemical used depends on the planned depth of the peel. The patient who is conscious feels a burning sensation that continues for 12 to 24 hours. Frequent small doses of analgesic and tranquilizing agents are prescribed to keep the patient comfortable. The most common complications include discoloration of the skin, infection of the burned area, persistent sensory changes or itching, and occasionally permanent scarring of the skin (Arif, 2015).

Dermabrasion

Dermabrasion is a form of skin abrasion used to treat acne scarring, aging, and sun-damaged skin. A special instrument (e.g., motor-driven wire brush, diamond-impregnated disc) is used. The epidermis and some superficial dermis are removed by a sanding-type action, and enough of the dermis is preserved to allow re-epithelization of the treated areas. Results are best in the face because it is rich in intradermal epithelial elements (Hession & Graber, 2015).

Patients with a history of herpes simplex viral infection are typically prescribed prophylactic antiviral medications (e.g., valacyclovir [Valtrex]) preprocedurally so that the physiologic stress of the procedure is less likely to cause a cutaneous herpes eruption. Tretinoin cream (Renova) may be prescribed with instructions to apply it 2 to 3 weeks preoperatively; this is associated with accelerating re-epithelialization post dermabrasion. Patients must be educated preprocedurally about the postprocedural dressing regimen and when to return to the primary provider to have dressing changes performed (Wong, Arnold, & Boeckman, 2016).

Facial Reconstructive Surgery

Reconstructive procedures on the face are individualized to the patient's needs and desired outcomes. They are performed to repair deformities or restore normal function. They may vary from closure of small defects to complicated procedures involving implantation of prosthetic devices to conceal a large defect or reconstruct a lost part of the face (e.g., nose, ear, jaw). Each surgical procedure is customized and involves a variety of incisions, flaps, and grafts. Multiple surgical procedures may be required.

The process of facial reconstruction is often slow and tedious. Because a person's facial appearance affects self-esteem so greatly, this type of reconstruction is often a very emotional experience for the patient.

Face-Lift

Rhytidectomy (face-lift) is a surgical procedure that removes soft tissue folds and minimizes cutaneous wrinkles on the face. It is performed to create a more youthful appearance. Psychological preparation requires that the patient recognize the limitations of surgery and the fact that miraculous rejuvenation will not occur. The patient is informed that the face may appear bruised and swollen after the dressings are removed and that several weeks may pass before the edema subsides. Corticosteroids (e.g., methylprednisolone) and vitamin C are prescribed postoperatively to minimize edema. Prophylactic antibiotic agents such as cephalexin (Keflex) may also be prescribed postoperatively (Warren & Neligan, 2013).

Laser Treatment of Cutaneous Lesions

Lasers are devices that amplify or generate highly specialized light energy. They can mobilize immense heat and power when focused at close range and are valuable tools in providing dermatologic abrasion therapy. The laser modalities used for this purpose today include scanned carbon dioxide laser, pulsed carbon dioxide laser, pulsed erbium/yttrium-aluminum-garnet (Er:YAG) laser, fractional Er:YAG laser resurfacing, combination carbon dioxide and Er:YAG lasers, and fractionated photothermolysis (Husain & Alster, 2016).

Each of these lasers is a precise surgical instrument that vaporizes and excises water-containing tissues with minimal damage. Because the beams used can seal blood and lymphatic vessels, they create a dry surgical field that makes many procedures easier and quicker. Therefore, these lasers are generally safe to use on patients with bleeding disorders or those receiving anticoagulant therapy. They are primarily used to improve the appearance of facial wrinkles, although they are also useful in removing epidermal nevi, tattoos, certain warts, skin cancer, ingrown toenails, and keloids. Incisions made with the laser beam heal and scar much like those made by a scalpel. Patients with a history of herpes simplex viral infection typically receive preprocedural antiviral prophylaxis (Husain & Alster, 2016).

Nursing Management

The majority of dermatologic and reconstructive procedures are performed in the physician's office or in an outpatient surgical department; therefore, most care takes place in the home. Most procedures, except very extensive reconstruction, are performed under local anesthesia or moderate sedation, therefore requiring a very short recovery time. Unless there are complications, the patient does not need hospitalization. The nurse must prepare both the patient and family for what to expect during the postoperative recovery time. Table 47-6 lists a few of the nursing considerations that must be reviewed in educating the patient and family.

Reconstructive Surgeries of the Congenital Defects

Reconstructive surgeries of the congenital defects have seen greater advancement in recent years. The congenital anomalies are one of the important causes for morbidity worldwide. These disorders are responsible for whopping 57.7 million disability-adjusted life years worldwide (WHO, 2013). Other than congenital heart disease, cleft lip, cleft palate, and hand abnormalities are major conditions requiring repair to maintain a reasonable quality of life. Affordability and accessibility to surgical correction is a major issue in low-income countries like India.

Reconstructive surgeries for polydactyly, syndactyly, and other types of hand and foot deformities give promising results.

Gender Reassignment

Gender reassignment surgery is a gender reaffirmation procedure that involves genital reconstruction to change

TABLE 47-6 Nursing Considerations in Cosmetic Procedures

Nursing Consideration	Interventions and Patient Education
Maintaining airway and pulmonary function	Cosmetic surgeries involving the face and neck can cause considerable swelling; bandages can restrict breathing or eating. Check dressings frequently, and ensure that no constriction occurs as swelling develops.
Relieving pain and achieving comfort	Procedures that involve a large surface area will cause considerable pain. Cool compresses or ice packs will relieve the burning of dermabrasion or chemical peels. Oral analgesic agents should be given regularly to control pain.
Maintaining adequate nutrition	When the face is involved, the patient may be unable to fully open the mouth, and chewing may be painful. Provide soft or liquid diet that is high in protein to assist with healing.
Enhancing communication	Depending on the type of cosmetic procedure, a nonverbal method of communication might be necessary until pain and swelling have subsided.
Improving self-concept	Recovery time from cosmetic procedures is slow. Expected results will take weeks to become apparent. Persons of color will experience increased pigmentation long after the initial wounds have healed. Helping patients to understand postoperative expectations will allow them to feel more comfortable with the healing process.
Promoting family coping	Most cosmetic procedures are performed in an outpatient facility; therefore, family members are integral to postoperative care. They should understand what to expect as the patient emerges from the procedure room: the type of dressings that will be in place, the skin care plan that is prescribed, and how to cope with the patient's pain.
Monitoring and managing potential complications	Infection is the most common complication, but excessive pain, nerve damage, and emotional distress about appearance are also common. If opioid analgesic agents are used, there may be gastrointestinal upset, mental status changes, or allergic reaction to the medication. Alert the caregiver to signs of these complications and how and when to report changes in status.

the genitalia from one gender to another. Transgenders may require gender reassignment surgery. Gender dysphoria is a condition classified in DSM-V as a type of mismatch between the perceived gender identity and the assigned biological sex. Individuals are attracted to the other sex and try to dress up and behave in confirmation to the opposite sex. During the time of puberty, they may experience intense anxiety and depression. Karyotyping may be performed to establish genetic abnormality before planning for gender reassignment procedure. Atypical sexual behaviors of the assigned sex or gender dysphoria is not an absolute indication for sex reassignment surgery as it involves lot of physical as well as psychological complications.

There are two types of sex reassignment procedure: male-to-female (MTF) and female-to-male surgery. Female-to-male surgery is a procedure that involves removal of the male sexual organ and reconstruction of a new vagina and breasts. After the surgery for adequate breast development and enhancement of the body shape, female hormones will be administered for at least 6 months (Gupta & Murarka, 2009). Counseling sessions with a psychologist need to be continued postsurgery as depression and suicidal ideations are very common.

Female-to-male surgery involves hormonal treatment, prosthetic implant, and reconstruction of functional phallus and urethra. Female-to-male gender reassignment surgery usually achieves lesser success due to the difficulty of creating a functioning penis from the much smaller clitoral tissue available in the female genitals. Apart from the genital organs, breasts also need to be surgically altered.

Legal Mandates for Gender Reassignment

Approval from two psychiatrists and psychologists and a certificate from a gynecologist are mandatory. Before the gender reassignment surgery, counseling sessions for 6 months with a qualified psychologist is a legal precondition (Gupta & Murarka, 2009). During these sessions, the risks involved are discussed. Parents and the young patients suffering from gender dysphoria need to be explained about the possible failure to achieve the desired results and other psychological disturbances.

Legal and Ethical Issues in Plastic Surgery

Plastic reconstructive surgeries are commonly performed to improve the functional and aesthetic appeal. Complications may arise following the procedures performed for the sole purpose of improving the look. Whenever the outcome of surgery is not in expected lines, it may attract legal suits against the treating surgeon and the team. An enormous amount of money and scarce medical resources are spent. The Government of India has not set the gender reassignment surgeries and other cosmetic procedures in the list of priority and these are not covered under health insurance schemes.

Autonomy and confidentiality are important aspects of legal and ethical issues in plastic reconstructive surgery. Nurses and health care professionals need to maintain a high degree of confidentiality about the treatment modalities and individual identities. Photographs taken for comparison purposes need to be taken and published after taking informed consent.

Skin Rejuvenation

Aging, heredity, stress, and excessive exposure to sunlight may lead to wrinkles, acne, scars, and loss of firmness and healthy glow. Skin rejuvenation refers to measures taken to bring back the lost contour and glow. There are numerous treatment modalities as well as over-the-counter cosmetic preparations.

Common skin rejuvenation treatments include chemical peels, laser, intense pulse light, ablative laser treatment, mechanical ablation, microneedling, dermafillers, and botulinum toxin. The skin rejuvenation therapies help in removing the scars, pigmentation, and sagging of the skin. Most of the skin conditions require multimodality and a series of treatment for excellent outcomes. Other than these therapies, cosmetic products such as moisturizers, lactic acids, humectants, retinoids, and antioxidants are widely used for aesthetic look (Grunebaum & Baumann, 2014). Stem cells derived from autologous adipose tissues, microfat, platelet therapies, and nanofat are effective in skin rejuvenation (Pourang, Rockwell, & Karim, 2020).

Derma Fillers

Derma fillers are substances used to augment soft tissues and to replace the lost subcutaneous fat. They are injectable materials used to lift up the sagging skin or facial folds that occur due to aging, heredity, or other reasons. Various types of derma fillers are available. Based on the origin, they can be classified as autograft, allograft, heterograft, and biosynthetic material. Temporary fillers are commonly biodegradable and last less than a year. Semipermanent materials such as cultured human fibroblasts may last from 1 to 2 years. Permanent derma fillers are synthetic and nonbiodegradable.

Some of the commonly used fillers are human collagen, porcine collagen, hyaluronic acids, autologous fats, and synthetic polymers. Usually, these products are injected superficially under the skin or a little beneath the dermal layer or deeply above the periosteal layers. Derma fillers may be used in augmenting the buttocks and breasts, lip enhancement, buccal cavity closure, correcting the skin folds, and correcting some skin diseases. They can be used alone or along with botulinum toxins.

Nursing Concerns

The procedure should be carried out with informed consent. The possible complications need to be explained. Preprocedure photographs are usually taken to compare the postprocedure effect. Nurses need to identify whether there is a history of allergy in the patients.

In the postprocedural phase, the nurse needs to instruct the patient not to massage or disturb the injected area for at least 6 hours. Strenuous exercises and exposure to extreme temperatures may also be avoided for at least 6 hours. On the day of the procedure, the patient has to sleep with the head end slightly elevated. Common complications are anaphylaxis, erythema, necrosis, and granuloma formation (Vedamurthy, 2008).

Liposuction

Liposuction is a surgical intervention in which excess subcutaneous fat is removed using a special cannula to achieve aesthetic body contour. It is otherwise called liposculpture or lipoplasty. Along with liposuction, lifestyle changes such as regular exercise, balanced diet, smoking, and alcohol cessation are important to achieve an optimal outcome. There are different types of liposuction, viz., suction-assisted liposuction, power-assisted liposuction, ultrasound-assisted liposuction, laser-assisted liposuction, and water-assisted liposuction.

Nurses need to assess the lifestyle and history of allergies before the procedure. Prior to the procedure, padding of the areas at risk for injury needs to be done. Post procedure, nurses should remain alert for possible thromboembolism as well as fat embolism. Nurse need to assist the patient to put on the compressive stockings. They should remain alert for fat embolism by observing for hypoxia, fever, tachypnea, and bilateral x-ray changes (Oliver, Pathan, & Mosahebi, 2016).

CRITICAL THINKING EXERCISES

1. A 45-year-old man sustains a steam burn while working on an offshore oil platform. He sustains third-degree burns over 65% of his body. He has delayed transportation to the nearest burn center. What should be the priorities of the first responders on the scene? On arrival to the treating facility, the patient's temperature is 35.2°C (95.3°F), and his weight is 62 kg. How should the treatment team at the burn treating facility prioritize this patient's care?
2. A 34-year-old woman is preparing dishes for a small birthday party of her son. In the process of cooking, the pressure pan burst and the contents of pan fell all over her right hand and forearm, and abdomen and anterior thighs. She is transported to the hospital for care. Using the rule of nines, what is her estimated TBSA? Based on the best evidence, what type of fluid should be used for resuscitation and why? What other information would you need to calculate her fluid requirements in the emergent/resuscitative phase?
3. A 69-year-old man was found down in the hallway of his apartment by firefighters, who extracted him from the smoke-filled building after being called to the scene by neighbors. He does not sustain obvious cutaneous burns. Upon interview and examination, he is tachypneic and exhibits hoarseness when speaking. You note singed nasal hair and lips. What is your immediate concern? What treatment should you expect the physician to prescribe first? Based on the current best evidence, what tests or procedures would most likely be prescribed to assist in the diagnosis and management of this patient?

REFERENCES

*Asterisk indicates nursing research.

Books

American Burn Association (ABA). (2011). Advanced burn life support (ABLS) course provider manual 2011. Chicago, IL: Author.

American Nurses Association. (2015). Code of ethics for nurses with interpretive statements. Washington, DC: American Nurses Publishing, American Nurses Foundation/American Nurses Association

Beauchamp, T. L., & Childress, J. F. (2012). Principles of biomedical ethics (7th ed.). New York: Oxford University Press.

Lee, J. O., Dibildox, M., Jimenez, C. J., et al. (2012). Operative wound management. In D. Herndon (Ed.): Total burn care (4th ed.). Edinburgh: Saunders Elsevier.

Mayhall, C. G. (2012). Healthcare-associated burn wound infections. In C. G. Mayhall (Ed.): Hospital epidemiology and infection control (4th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Oliver, N., Pathan, O. K., & Mosahebi, A. (2016). Liposuction. In M. D. Kalaskar, E. P. Buttler, & S. Ghali (Eds.): Textbook of plastic and reconstructive surgery (pp. 333–356). London: UCL Press.

Serghiou, M. A., Ott, S., Whitehead, C., et al. (2012). Comprehensive rehabilitation of the burn patient. In D. Herndon (Ed.): Total burn care (4th ed.). Edinburgh: Saunders Elsevier.

Urden, L. D., Stacy, K. M., & Lough, M. E. (2014). Critical care nursing: Diagnosis and management (7th ed.). St. Louis, MO: Elsevier Mosby.

Warren, R. J., & Neligan, P. C. (2013). Plastic surgery (3rd ed.). St. Louis, MO: Elsevier Mosby.

Wong, B., Arnold, M., & Boeckmann, J. (2016). Facial plastic and reconstructive surgery. New York: Springer.

Journals and Electronic Documents

Abdullahi, A., & Jeschke, M. G. (2014). Nutrition and anabolic pharmacotherapies in the care of burn patients. Nutrition in Clinical Practice, 29(5), 621–630.

American Burn Association (ABA). (2014). *Burn center verification*. Retrieved on 6/12/2016 at: www.ameriburn.org/verification_verifiedcenters.php

Arif, T. (2015). Salicylic acid as a peeling agent: A comprehensive review. Clinical, Cosmetic and Investigational Dermatology, 8, 455–461.

Bhansali, C.A., Gandhi, G., Sahastrabudhe, P, Panse. N. (2017). Epidemiological study of burn injuries and its mortality risk factors in a tertiary care hospital, Indian Journal of Burns 25, 62–66.

*Bishop, S. M., Walker, M. D., & Spivak, I. M. (2013). Family presence in the adult burn intensive care unit during dressing changes. Critical Care Nurse, 33(1), 14–23.

Cahill, K. C., Tiong, W. H. C. & Conroy, F. J. (2013). Trineural injury to the right hand after domestic electrocution. Journal of Burn Care and Research, 35(5), e353–e356.
Clark, J. M., Wang, T. D., & Terris, D. J. (2015). Skin flap design. Medscape. Retrieved on 2/3/2017 at: emedicine.medscape.com/article/875968-overview.
Davis, J. S., Rodriquez, L. I., Quintana, O. D., et al. (2013). Use of a warming catheter to achieve normothermia in large burns. Journal of Burn Care and Research, 34(1), 191–195.
Dries, D. J., & Endorf, F. W. (2013). Inhalation injury: Epidemiology, pathology, treatment strategies. Scandinavian Journal of Trauma, Resuscitation & Emergency Medicine, 21, 31. doi: 10.1186/1757–7241–21–31
*Fahlstrom, K., Boyle, C., & Makic, M. B. F. (2013). Implementation of a nurse-driven burn resuscitation protocol: A quality improvement project. Critical Care Nurse, 33(1), 25–35.
Flores, O., Stockton, K., Roberts, J. A., et al. (2015). The efficacy and safety of adrenergic blockade after burn injury: A systematic review and meta-analysis. Journal of Trauma and Acute Care Surgery, 80(1), 146–155.
Grunebaum, D. l., & Baumann, S. L. (2014). Nonprescription topical treatments for skin rejuvenation. Facial Plastic Surgery, 30, 3–11.
Gupta, A. K., Asirvatham, E., Reddy, K. A., et al. (2021). Fluid resuscitation in adult burns. Current Medical Issues, 19(2), 103–109.
Gupta, R., & Murarka, A. (2009). Treating transsexuals in India: History, prerequisites for surgery and legal issues. Indian Journal of Plastic Surgery, 42(2), 226–233.
Hermans, M. E. (2014). Porcine xenografts vs. (cryopreserved) allografts in the management of partial thickness burns: Is there a clinical difference? Burns, 40(3), 408–415.
Hession., M. T., & Graber, E. M. (2015). Atrophic acne scarring: Review of treatment options. The Journal of Clinical and Anesthetic Dermatology, 8(1), 50.
Hobbs, K. (2014). Which factors influence the development of post-traumatic stress disorder in patients with burn injuries? A systematic review of the literature. Burns, 41(3), 421–430.
Hostler, D., Weaver, M. D., Ziembicki, J. A., et al. (2013). Admission temperature and survival in patients admitted to burn centers. Journal of Burn Care and Research, 34(5), 498–506.
Hourigan, L. A., Omaye, S. T., Keen, C. L., et al. (2016). Vitamin and trace element loss from negative-pressure wound therapy. Advances in Skin & Wound Care, 29(1), 20–25.
Husain, Z., & Alster, T. S. (2016). The role of lasers and intense pulsed light technology in dermatology. Clinical, Cosmetic and Investigational Dermatology, 9, 29–40.
Jeschke, M. G., Finnerty, C. C., Shahrokhi, S., et al. (2013). Wound coverage technologies in burn care: Novel techniques. Journal of Burn Care and Research, 34(6), 612–620.
Jeschke, M. G., Patsouris, D., Stanojcic, M., et al. (2015, August 6). Pathophysiologic response to burns in the elderly. EBioMedicine, 2(10), 1536–1548. Retrieved on 8/31/2015 at: www.ebiomedicine.com /action/doSearch?searchType=quick&searchText=pathophysiologic+response+to+burns+in+the+elderly&occurrences=all&journalCode=ebiom&searchScope=fullSite
Jeschke, M. G., Pinto, R., Kraft, R., et al. (2015). Morbidity and survival probability in burn patients in modern burn care. Critical Care Medicine, 43(4), 808–815.
Justiniano, C. F., Coffey, R. A., Evans, D. C., et al. (2015). Comorbidity-polypharmacy score predicts in-hospital complications and the need for discharge to extended care facility in older burn patients. Journal of Burn Care and Research, 36(1), 193–196.
Kearns, R. D., Cairns, C. B., Holmes, J. H., et al. (2013). Thermal burns: A review of best practice. EMS World, 42(1), 43–51.
*Klas, K. S., Smith, S. J., Matherly, A. F., et al. (2015). Multicenter assessment of burn team injury prevention knowledge. Journal of Burn Care and Research, 36(3), 434–439.
Kwon, K. H., Kim, S. H., & Minn Y. K. (2014). Electrodiagnostic study of peripheral nerves in high-voltage electrical injury. Journal of Burn Care and Research, 35(4), e230–233.
Kym, D., Yim, H., Yoon, J., et al. (2015). The application of cultured epithelial autografts improves survival in burns. Wound Repair and Regeneration, 23, 340–344.
Mann-Salinas, E. A., Baun, M. M., Meininger, J. C., et al. (2013) Novel predictors of sepsis outperform the American Burn Association sepsis criteria in the burn intensive care unit patient. Journal of Burn Care and Research, 34(1), 31–43.
Micromedex 2.0. (2015). Formulary advisor, University of Texas–Medical Branch Galveston. Retrieved on 7/10/2015 (pass-protected) at: www.micromedicsolutions.com/micromedex2/librarian
Meyerson, J. M., Coffey, R, Jones, L. M., et al. (2015). Burn center barrier protocols during dressing change: A national survey. Journal of Burn Care and Research, 36(4), 238–234.
National Oceanic and Atmospheric Administration. (2015). *Lightning safety*. Retrieved on 6/10/2016 at: www.lightningsafety.noaa.gov/index.shtml
Nitzschke, S. L., Adem, J. K., Serio-Melvin, M. L., et al. (2014). Wound healing trajectories in burn patients and their impact on mortality. Journal of Burn Care and Research, 35(6), 474–479.
Overview of gender reassignment. Retrieved on April 26/4/2022 at: https://www.sciencedirect.com/topics/medicine-and-dentistry/sex-reassignment-surgery.
Pourang, A., Rockwell, H., & Karim, K. (2020). New frontiers in skin rejuvenation including stem cells and autologous therapies. Facial Plastic Surgery Clinics of North America, 28, 101–117.
Rousseau, A., Massion, P. B., Laungani, A., et al. (2014). Toward targeted early burn care: Lessons from a European survey. Journal of Burn Care and Research, 35(4), e234–e239.
Russell, K. W., Cochran, A. L., Mehta, S. T., et al. (2013). Lightning burns. Journal of Burn Care and Research, 35(6), e436–e438.
Satahoo, S. S., Parikh, P. P., Naranjo, D., et al. (2015). Are burn patients really at risk for thrombotic events? Journal of Burn Care and Research, 36(1), 100–104.
Sen, S., Palmieri, T., & Greenhalgh, D. (2015). Review of burn research for year 2014. Journal of Burn Care and Research, 36(6), 587–594.
Snell, J. A., Loh N. W., Mahambrey, T, et al. (2013). Clinical review: The critical care management of the burn patient. Critical Care, 17(5), 241.
Stergiou-Kita, M., Mansfield, E., Bayley, M., et al. (2014). Returning to work after electrical injuries: Workers' perspectives and advice to others. Journal of Burn Care and Research, 35(6), 498–507.
Trexler, S. T., Lundy, J. B., Chung, K. K., et al. (2014). Prevalence and impact of late defecation in the critically ill, thermally injured adult patient. Journal of Burn Care and Research, 35(4), e224–e229.
Vedamurthy, M. (2008). Standard guidelines for the use of dermal fillers. Indian Journal of Dermatology, Venereology and Leprology, 74, 23–27.
World Health Organization (WHO). (2013). Emergency and essential surgical care: Congenital anomalies. http://www.who.int/surgery/challenges/esc_congenital_nomalies/en/.
Wibbenmeyer, L., Eid, A., Liao, J. et al. (2014). Gabapentin is ineffective as an analgesic agent in the immediate postburn period. Journal of Burn Care and Research, 35(2), 136–142.
World Health Organization (WHO). (2014). *Fact sheet No. 365. Burns*. Retrieved on 6/12/2016 at: www.who.int/mediacentre/factsheets/fs365/en/

Resources

Alisa Ann Ruch Burn Foundation, www.aarbf.org
American Burn Association (ABA), www.ameriburn.org
American Red Cross, www.redcross.org
Burn Foundation, www.burnfoundation.org
Burn Institute, www.burninstitute.org
Burn Prevention Network, www.burnprevention.org
Firefighters Burn Institute, www.ffburn.org
International Association of Fire Fighters, www.iaff.org
International Society for Burn Injuries (ISBI), www.worldburn.org
Lund-Browder Classification, medical-dictionary.thefreedictionary.com/Lund-Browder+classification
National Fire Protection Association (NFPA), www.nfpa.org
U.S. Fire Administration, www.usfa.fema.gov

UNIT

XVI Neurologic Function

Chapter 48 Assessment of Neurologic Function 1543

Chapter 49 Management of Patients with Neurologic Dysfunction 1569

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CHAPTER 48

Assessment of Neurologic Function

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe the structures and functions of the central and peripheral nervous systems.
2. Differentiate between pathologic changes that affect motor control and those that affect sensory pathways.
3. Compare and contrast the functioning of the sympathetic and parasympathetic nervous systems.
4. Explain the significance of physical assessment to the diagnosis of neurologic dysfunction.
5. Identify changes in neurologic function associated with aging and their impact on neurologic assessment findings.
6. Discuss diagnostic tests used for assessment of suspected neurologic disorders and the related nursing implications.

GLOSSARY

agnosia: loss of ability to recognize objects through a particular sensory system; may be visual, auditory, or tactile
ataxia: inability to coordinate muscle movements, resulting in difficulty in walking, talking, and performing self-care activities
autonomic nervous system: division of the nervous system that regulates the involuntary body functions
axon: portion of the neuron that conducts impulses away from the cell body
Babinski reflex (sign): a reflex action of the toes; in adults is indicative of abnormalities in the motor control pathways leading from the cerebral cortex
clonus: abnormal movement marked by alternating contraction and relaxation of a muscle occurring in rapid succession
delirium: an acute, confused state that begins with disorientation and if not recognized and treated early can progress to changes in level of consciousness, irreversible brain damage, and sometimes death
dendrite: portion of the neuron that conducts impulses toward the cell body
flaccidity: displaying lack of muscle tone; limp, floppy
parasympathetic nervous system: division of the autonomic nervous system active primarily during nonstressful conditions, controlling mostly visceral functions
position (postural) sense: awareness of position of parts of the body without looking at them; also referred to as proprioception
reflex: an automatic response to stimuli
rigidity: increase in muscle tone at rest characterized by increased resistance to passive stretch
Romberg test: test for cerebellar dysfunction that can be done with the patient seated or standing; inability to maintain position for 20 seconds is a positive test
spasticity: sustained increase in tension of a muscle when it is passively lengthened or stretched
sympathetic nervous system: division of the autonomic nervous system with predominantly excitatory responses; the "fight-or-flight" system
vertigo: illusion of movement in which the individual or the surroundings are sensed as moving

Introduction

Nurses in many practice settings encounter patients with altered neurologic function. Disorders of the nervous system can occur at any time during the lifespan and can vary from mild, self-limiting symptoms to devastating, life-threatening disorders. Nurses must be skilled in the general assessment of neurologic function and be able to focus on specific areas as needed. Assessment requires knowledge of the anatomy and physiology of the nervous system and an understanding of the array of tests and procedures used to diagnose neurologic disorders. Knowledge about the nursing implications and interventions related to assessment and diagnostic testing is also essential.

Anatomic and Physiologic Overview

The nervous system consists of two major parts: the central nervous system (CNS), including the brain and spinal cord, and the peripheral nervous system, which includes the cranial nerves, spinal nerves, and autonomic nervous system. The function of the nervous system is to control motor, sensory, autonomic, cognitive, and behavioral activities. The brain itself contains more than 100 billion cells that link the motor and sensory pathways, monitor the body's processes, respond to the internal and external environment, maintain homeostasis, and direct all psychological, biologic, and physical activity through complex chemical and electrical messages (Klein & Stewart-Amidei, 2012).

Cells of the Nervous System

The basic functional unit of the brain is the neuron (see Fig. 48-1). It is composed of dendrites, a cell body, and an axon. The dendrites are branch-type structures for receiving electrochemical messages. The axon is a long projection that carries electrical impulses away from the cell body. Some axons have a myelinated sheath that increases speed of conduction. Nerve cell bodies occurring in clusters are called *ganglia* or *nuclei.* A cluster of cell bodies with the same function is called a *center* (e.g., the respiratory center). Neurons are supported, protected, and nourished by glial cells, which are 50 times greater in number than neurons (Hickey, 2014).

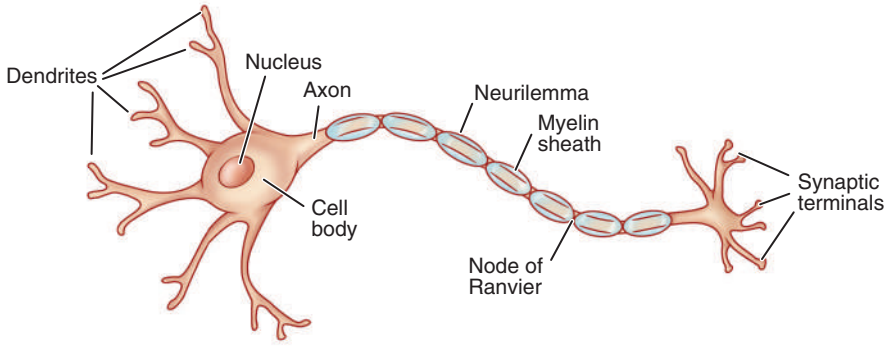


Figure 48-1 • Neuron.

Neurotransmitters

Neurotransmitters communicate messages from one neuron to another or from a neuron to a target cell, such as muscle or endocrine cells. Neurotransmitters are manufactured and stored in synaptic vesicles. As an electrical action potential moves along the axon and reaches the nerve terminal, neurotransmitters are released into the synapse. The neurotransmitter is transported across the synapse, binding to receptors on the postsynaptic cell membrane. A neurotransmitter can either excite or inhibit activity of the target cell. Usually, multiple neurotransmitters are at work in the neural synapse. The source and action of major neurotransmitters are described in Table 48-1. Once released, enzymes either destroy the neurotransmitter or reabsorb it into the neuron for future use.

Many neurologic disorders are due, at least in part, to an imbalance in neurotransmitters. For example, Parkinson disease develops from decreased availability of dopamine, whereas acetylcholine binding to muscle cells is impaired in myasthenia gravis (Porth, 2014). All brain functions are modulated through neurotransmitter receptor site activity, including memory and other cognitive processes (Hickey, 2014).

Ongoing research is evaluating diagnostic tests that can detect abnormal levels of neurotransmitters in the brain. Positron emission tomography (PET), for example, can detect dopamine, serotonin, and acetylcholine. Single-photon emission computed tomography (SPECT), similar to PET, can detect changes in some neurotransmitters, such as dopamine in Parkinson disease (Fischbach & Dunning, 2015). Both PET and SPECT are discussed in more detail later in this chapter.

The Central Nervous System

The Brain

The brain accounts for approximately 2% of the total body weight; in an average young adult, the brain weighs approximately 1400 g, whereas in an average older adult, the brain weighs approximately 1200 g (Hickey, 2014). The brain is divided into three major areas: the cerebrum, the brain stem, and the cerebellum. The cerebrum is composed of two hemispheres, the thalamus, the hypothalamus, and the basal ganglia. The brain stem includes the midbrain, pons, and medulla. The cerebellum is located under the cerebrum and behind the brain stem (see Fig. 48-2).

Cerebrum

The outside surface of the hemispheres has a wrinkled appearance that is the result of many folded layers or convolutions called *gyri,* which increase the surface area of the brain, accounting for the high level of activity carried out by such a small-appearing organ. Between each gyrus is a sulcus or fissure that serves as an anatomic division. In between the cerebral hemispheres is the great longitudinal fissure that separates the cerebrum into the right and left hemispheres. The two hemispheres are joined at the lower portion of the fissure

TABLE 48-1 Major Neurotransmitters

Neurotransmitter	Source	Action
Acetylcholine (major transmitter of the parasympathetic nervous system)	Many areas of the brain; autonomic nervous system	Usually excitatory; parasympathetic effects sometimes inhibitory (stimulation of heart by vagal nerve)
Serotonin	Brain stem, hypothalamus, dorsal horn of the spinal cord	Inhibitory; helps control mood and sleep, inhibits pain pathways
Dopamine	Substantia nigra and basal ganglia	Usually inhibitory; affects behavior (attention, emotions) and fine movement
Norepinephrine (major transmitter of the sympathetic nervous system)	Brain stem, hypothalamus, postganglionic neurons of the sympathetic nervous system	Usually excitatory; affects mood and overall activity
Gamma-aminobutyric acid	Spinal cord, cerebellum, basal ganglia, some cortical areas	Inhibitory
Enkephalin, endorphin	Nerve terminals in the spine, brain stem, thalamus and hypothalamus, pituitary gland	Excitatory; pleasurable sensation, inhibits pain transmission

Adapted from Porth, C. M. (2014). Essentials of pathophysiology (4th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

by the corpus callosum. The external or outer portion of the hemispheres (the cerebral cortex) is made up of gray matter approximately 2 to 5 mm in depth; it contains billions of neuron cell bodies, giving it a gray appearance. White matter makes up the innermost layer and is composed of myelinated nerve fibers and neuroglia cells that form tracts or pathways connecting various parts of the brain with one another. These pathways also connect the cortex with lower portions of the brain and spinal cord. The cerebral hemispheres are divided into pairs of lobes as follows (see Fig. 48-2):

- *Frontal*—the largest lobe, located in the front of the brain. The major functions of this lobe are concentration, abstract thought, information storage or memory, and motor function. It contains Broca area, which is located in the left hemisphere and is critical for motor control of speech. The frontal lobe is also responsible in large part for a person's affect, judgment, personality, and inhibitions (Hickey, 2014).
- *Parietal*—a predominantly sensory lobe posterior to the frontal lobe. This lobe analyzes sensory information and relays the interpretation of this information to other cortical areas and is essential to a person's awareness of body position in space, size and shape discrimination, and right–left orientation (Hickey, 2014).
- *Temporal*—located inferior to the frontal and parietal lobes, this lobe contains the auditory receptive areas and plays a role in memory of sound and understanding of language and music.
- *Occipital*—located posterior to the parietal lobe, this lobe is responsible for visual interpretation and memory.

The corpus callosum (see Fig. 48-3), a thick collection of nerve fibers that connects the two hemispheres of the brain, is responsible for the transmission of information from one side of the brain to the other. Information transferred includes sensation, memory, and learned discrimination. Right-handed people and some left-handed people have cerebral dominance on the left side of the brain for verbal, linguistic, arithmetic, calculation, and analytic functions. The nondominant hemisphere is responsible for geometric, spatial, visual, pattern, and musical functions. Nuclei for cranial nerves I and II are also located in the cerebrum.

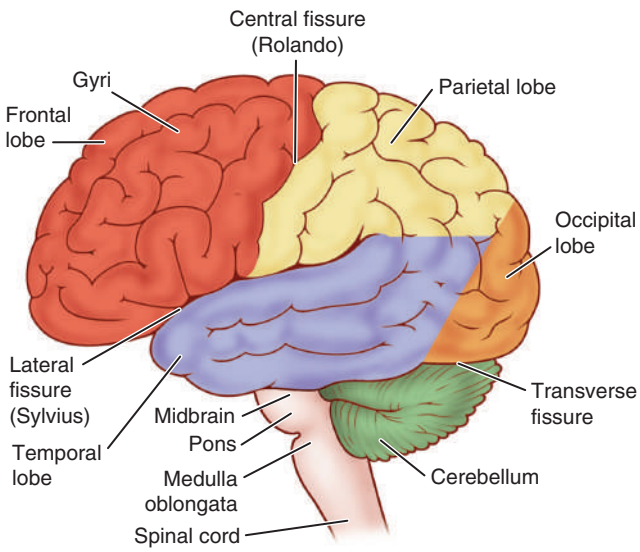


Figure 48-2 • View of the external surface of the brain showing lobes, cerebellum, and brain stem.

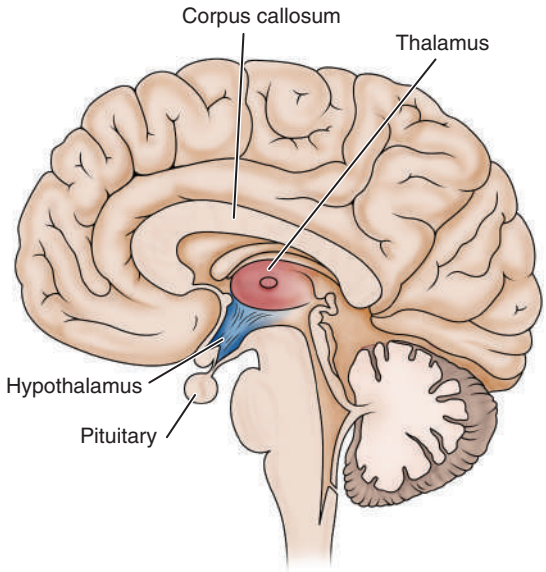


Figure 48-3 • Medial view of the brain.

The thalami lie on either side of the third ventricle and act primarily as a relay station for all sensation except smell. All memory, sensation, and pain impulses pass through this section of the brain. The hypothalamus (see Fig. 48-3) is located anterior and inferior to the thalamus, and beneath and lateral to the third ventricle. The infundibulum of the hypothalamus connects it to the posterior pituitary gland. The hypothalamus plays an important role in the endocrine system because it regulates the pituitary secretion of hormones that influence metabolism, reproduction, stress response, and urine production. It works with the pituitary to maintain fluid balance through hormonal release and maintains temperature regulation by promoting vasoconstriction or vasodilatation. In addition, the hypothalamus is the site of the hunger center and is involved in appetite control. It contains centers that regulate the sleep–wake cycle, blood pressure, aggressive and sexual behavior, and emotional responses (i.e., blushing, rage, depression, panic, and fear). The hypothalamus also controls and regulates the autonomic nervous system. The optic chiasm (the point at which the two optic tracts cross) and the mammillary bodies (involved in olfactory reflexes and emotional response to odors) are also found in this area.

The basal ganglia are masses of nuclei located deep in the cerebral hemispheres that are responsible for control of fine motor movements, including those of the hands and lower extremities.

Brain Stem

The brain stem consists of the midbrain, pons, and medulla oblongata (see Fig. 48-2). The midbrain connects the pons and the cerebellum with the cerebral hemispheres; it contains sensory and motor pathways and serves as the center for auditory and visual reflexes. Cranial nerves III and IV originate in the midbrain. The pons is situated in front of the cerebellum between the midbrain and the medulla and is a bridge between the two halves of the cerebellum, and between the medulla and the midbrain. Cranial nerves V through VIII originate in

the pons. The pons also contains motor and sensory pathways. Portions of the pons help regulate respiration.

Motor fibers from the brain to the spinal cord and sensory fibers from the spinal cord to the brain are located in the medulla. Most of these fibers cross, or decussate, at this level. Cranial nerves IX through XII originate in the medulla. Reflex centers for respiration, blood pressure, heart rate, coughing, vomiting, swallowing, and sneezing are also located in the medulla. The reticular formation, responsible for arousal and the sleep–wake cycle, begins in the medulla and connects with numerous higher structures.

Cerebellum

The cerebellum is posterior to the midbrain and pons, and below the occipital lobe (see Fig. 48-2). The cerebellum integrates sensory information to provide smooth coordinated movement. It controls fine movement, balance, and position (postural) sense or proprioception (awareness of position of extremities without looking at them).

Structures Protecting the Brain

The brain is contained in the rigid skull, which protects it from injury. The major bones of the skull are the frontal, temporal, parietal, occipital, and sphenoid bones. These bones join at the suture lines (see Fig. 48-4) and form the base of the skull. Indentations in the skull base are known as fossae. The anterior fossa contains the frontal lobe, the middle fossa contains the temporal lobe, and the posterior fossa contains the cerebellum and brain stem.

The meninges (fibrous connective tissues that cover the brain and spinal cord) provide protection, support, and nourishment. The layers of the meninges are the dura mater, arachnoid, and pia mater (see Fig. 48-5):

- *Dura mater*—the outermost layer; covers the brain and the spinal cord. It is tough, thick, inelastic, fibrous, and gray. There are three major extensions of the dura: the falx cerebri, which folds between the two hemispheres; the tentorium, which folds between the occipital lobe and cerebellum to form a tough, membranous shelf; and the falx cerebelli, which is located between the right and left side of the cerebellum. When excess pressure occurs in the cranial cavity, brain tissue may be compressed against these dural folds or displaced around them, a process called *herniation*. A potential space exists between the dura and the skull, and between the periosteum and the dura in the vertebral column, known as the epidural space. Another potential space, the subdural space, also exists below the dura. Blood or an abscess can accumulate in these potential spaces.
- *Arachnoid*—the middle membrane; an extremely thin, delicate membrane that closely resembles a spider web (hence the name *arachnoid*). The arachnoid membrane has cerebrospinal fluid (CSF) in the space below it, known as the subarachnoid space. This membrane has arachnoid villi, which are unique finger-like projections that absorb CSF into the venous system. When blood or bacteria enter the subarachnoid space, the villi become obstructed and *communicating* hydrocephalus (increased size of ventricles) may result.
- *Pia mater*—the innermost, thin, transparent layer that hugs the brain closely and extends into every fold of the brain's surface.

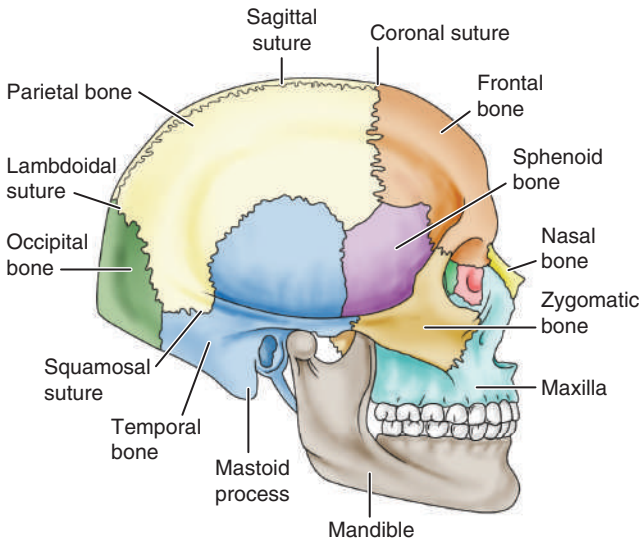


Figure 48-4 • Bones and sutures of the skull.

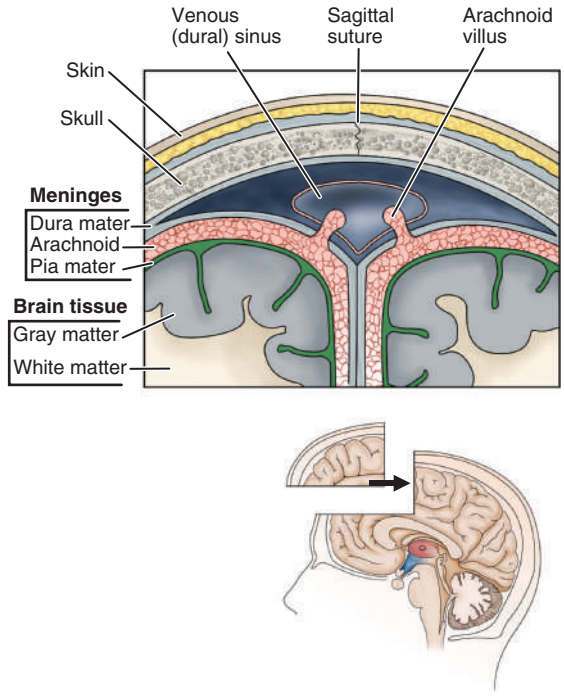


Figure 48-5 • Meninges and related structures.

Cerebrospinal Fluid

CSF is a clear and colorless fluid that is produced in the choroid plexus of the ventricles and circulates around the surface of the brain and the spinal cord. There are four ventricles: the right and left lateral and the third and fourth ventricles. The two lateral ventricles open into the third ventricle at the interventricular foramen (also known as the foramen of Monro). The third and fourth ventricles connect via the aqueduct of Sylvius. The fourth ventricle drains CSF into the subarachnoid space on the surface of the brain and spinal cord, where it is absorbed by the arachnoid villi. Blockage of the flow of CSF anywhere in the ventricular system produces *obstructive* hydrocephalus.

CSF is important in immune and metabolic functions in the brain. It is produced at a rate of about 500 mL/day; the ventricles and subarachnoid space contain approximately 150 mL of

fluid (Hickey, 2014). The composition of CSF is similar to other extracellular fluids (such as blood plasma), but the concentrations of the various constituents differ. A laboratory analysis of CSF indicates color (clear), specific gravity (normal 1.007), protein count, cell count, glucose, and other electrolyte levels (see Table A-5 in Appendix A). Normal CSF contains a minimal number of white blood cells and no red blood cells. The CSF may also be tested for immunoglobulins or the presence of bacteria. A CSF sample may be obtained through a lumbar puncture or intraventricular catheter (Hickey, 2014).

Cerebral Circulation

The brain does not store nutrients and requires a constant supply of oxygen. These needs are met through cerebral circulation; the brain receives approximately 15% of the cardiac output, or 750 mL per minute of blood flow. Brain circulation is unique in several aspects. First, arterial and venous vessels are not parallel as in other organs in the body; this is due in part to the role the venous system plays in CSF absorption. Second, the brain has collateral circulation through the circle of Willis (see later discussion), allowing blood flow to be redirected on demand. Third, blood vessels in the brain have two rather than three layers, which may make them more prone to rupture when weakened or under pressure.

Arteries

Arterial blood supply to the anterior brain originates from the common carotid artery, which is the first bifurcation off the aorta. The internal carotid arteries arise at the bifurcation of the common carotid. Branches of the internal carotid arteries (the anterior and middle cerebral arteries) and their connections (the anterior and posterior communicating arteries) form the circle of Willis (see Fig. 48-6).

The vertebral arteries branch from the subclavian arteries to supply most of the posterior circulation of the brain. At the level of the brain stem, the vertebral arteries join to form the basilar artery. The basilar artery divides to form the two branches of the posterior cerebral arteries. Functionally, the posterior and anterior portions of the circulation usually remain separate. However, the circle of Willis can provide collateral circulation through communicating arteries if one of the vessels supplying it becomes occluded or is ligated.

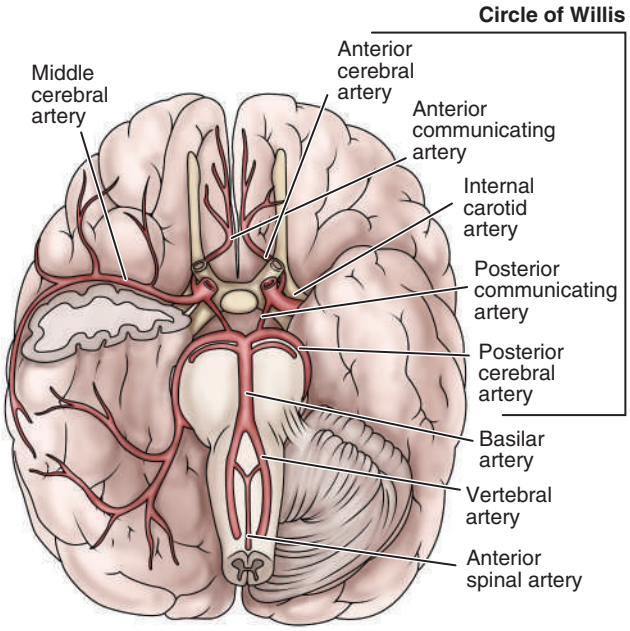


Figure 48-6 • Arterial blood supply of the brain, including the circle of Willis, as viewed from the ventral surface.

The bifurcations along the circle of Willis are frequent sites of aneurysm formation. Aneurysms are outpouchings of the blood vessel due to vessel wall weakness. Aneurysms can rupture and cause a hemorrhagic stroke. See Chapter 50 for a more detailed discussion of aneurysms.

Veins

Venous drainage for the brain does not follow the arterial circulation as in other body structures. The veins reach the brain's surface, join larger veins, and then cross the subarachnoid space and empty into the dural sinuses, which are the vascular channels embedded in the dura (see Fig. 48-5). The network of the sinuses carries venous outflow from the brain and empties into the internal jugular veins, returning the blood to the heart. Cerebral veins are unique, because unlike other veins in the body, they do not have valves to prevent blood from flowing backward and depend on both gravity and blood pressure for flow.

Blood–Brain Barrier

The CNS is inaccessible to many substances that circulate in the blood plasma (e.g., dyes, medications, and antibiotic agents) because of the blood–brain barrier. This barrier is formed by the endothelial cells of the brain's capillaries, which form continuous tight junctions, creating a barrier to macromolecules and many compounds. All substances entering the CSF must filter through the capillary endothelial cells and astrocytes. The blood–brain barrier has a protective function but can be altered by trauma, cerebral edema, and cerebral hypoxemia; this has implications for treatment and selection of medications for CNS disorders (Hickey, 2014).

The Spinal Cord

The spinal cord is continuous with the medulla, extending from the cerebral hemispheres and serving as the connection between the brain and the periphery. Approximately 45 cm (18 inches) long and about the thickness of a finger, it extends from the foramen magnum at the base of the skull to the lower border of the first lumbar vertebra, where it tapers to a fibrous band called the *conus medullaris*. Continuing below the second lumbar space are the nerve roots that extend beyond the conus, which are called the *cauda equina* because they resemble a horse's tail. Meninges surround the spinal cord.

In a cross-sectional view, the spinal cord has an H-shaped central core of nerve cell bodies (gray matter) surrounded by ascending and descending tracts (white matter) (see Fig. 48-7). The lower portion of the H is broader than the upper portion and corresponds to the anterior horns. The anterior horns contain cells with fibers that form the anterior (motor) root and are essential for the voluntary and reflex activity of the muscles they innervate. The thinner posterior (upper horns) portion contains cells with fibers that enter over the posterior (sensory) root and thus serve as a relay station in the sensory/reflex pathway.

The thoracic region of the spinal cord has a projection from each side at the crossbar of the H-shaped structure of gray matter called the *lateral horn*. It contains the cells that give rise to the autonomic fibers of the sympathetic division. The fibers

leave the spinal cord through the anterior roots in the thoracic and upper lumbar segments.

The Spinal Tracts

The white matter of the spinal cord is composed of myelinated and unmyelinated nerve fibers. The fast-conducting myelinated fibers form bundles; fiber bundles with a common function are called *tracts*.

There are six ascending tracts (see Fig. 48-7). Two tracts, known as the fasciculus cuneatus and gracilis or the posterior columns, conduct sensations of deep touch, pressure, vibration, position, and passive motion from the same side of the body. Before reaching the cerebral cortex, these fibers cross to the opposite side in the medulla. The anterior and posterior spinocerebellar tracts conduct sensory impulses from muscle spindles, providing necessary input for coordinated muscle contraction. They ascend uncrossed and terminate in the cerebellum. The anterior and lateral spinothalamic tracts are responsible for conduction of pain, temperature, proprioception, fine touch, and vibratory sense from the upper body to the brain. They cross to the opposite side of the cord and then ascend to the brain, terminating in the thalamus (Klein & Stewart-Amidei, 2012).

There are eight descending tracts (see Fig. 48-7). The anterior and lateral corticospinal tracts conduct motor impulses to the anterior horn cells from the opposite side of the brain, cross in the medulla, and control voluntary muscle activity. The three vestibulospinal tracts descend uncrossed and are involved in some autonomic functions (sweating, pupil dilation, and circulation) and involuntary muscle control. The corticobulbar tract conducts impulses responsible for voluntary head and facial muscle movement and crosses at the level of the brain stem. The rubrospinal and reticulospinal tracts conduct impulses involved with involuntary muscle movement.

Vertebral Column

The bones of the vertebral column surround and protect the spinal cord and normally consist of 7 cervical, 12 thoracic, and 5 lumbar vertebrae, as well as the sacrum (a fused mass of 5 vertebrae), and terminate in the coccyx. Nerve roots exit from the vertebral column through the intervertebral foramina (openings). The vertebrae are separated by discs, except for the first and second cervical, the sacral, and the coccygeal vertebrae. Each vertebra has a ventral solid body and a dorsal segment or arch, which is posterior to the body. The arch is composed of two pedicles and two laminae supporting seven processes.

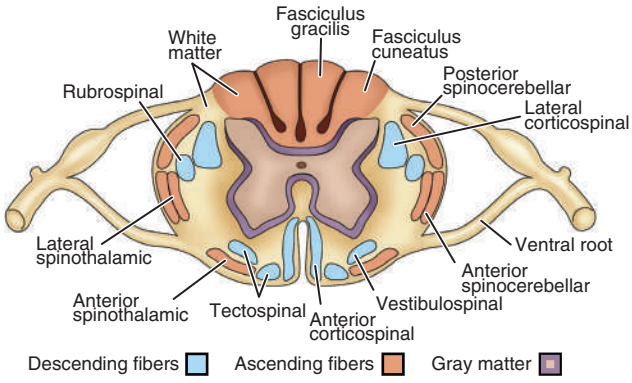


Figure 48-7 • Cross-sectional diagram of the spinal cord showing major spinal tracts.

The vertebral body, arch, pedicles, and laminae all encase and protect the spinal cord.

The Peripheral Nervous System

The peripheral nervous system includes the cranial nerves, the spinal nerves, and the autonomic nervous system.

Cranial Nerves

Twelve pairs of cranial nerves emerge from the lower surface of the brain and pass through openings in the base of the skull. Three cranial nerves are entirely sensory (I, II, VIII), five are motor (III, IV, VI, XI, and XII), and four are mixed sensory and motor (V, VII, IX, and X). The cranial nerves are numbered in the order in which they arise from the brain (see Fig. 48-8). The cranial nerves innervate the head, neck, and special sense structures. Table 48-2 identifies primary functions of the cranial nerves.

Spinal Nerves

The spinal cord is composed of 31 pairs of spinal nerves: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal. Each spinal nerve has a ventral root and a dorsal root. The dorsal roots are sensory and transmit sensory impulses from specific areas of the body known as dermatomes (see Fig. 48-9) to the dorsal horn ganglia. The sensory fiber may be somatic, carrying information about pain, temperature, touch, and position sense (proprioception) from the tendons, joints, and body surfaces; or visceral, carrying information from the internal organs.

The ventral roots are motor and transmit impulses from the spinal cord to the body; these fibers are also either somatic or visceral. The visceral fibers include autonomic fibers that control the cardiac muscles and glandular secretions.

Autonomic Nervous System

The autonomic nervous system regulates the activities of internal organs such as the heart, lungs, blood vessels, digestive organs, and glands (see Fig. 48-10). Maintenance and restoration of internal homeostasis is largely the responsibility of the autonomic nervous system. There are two major divisions:

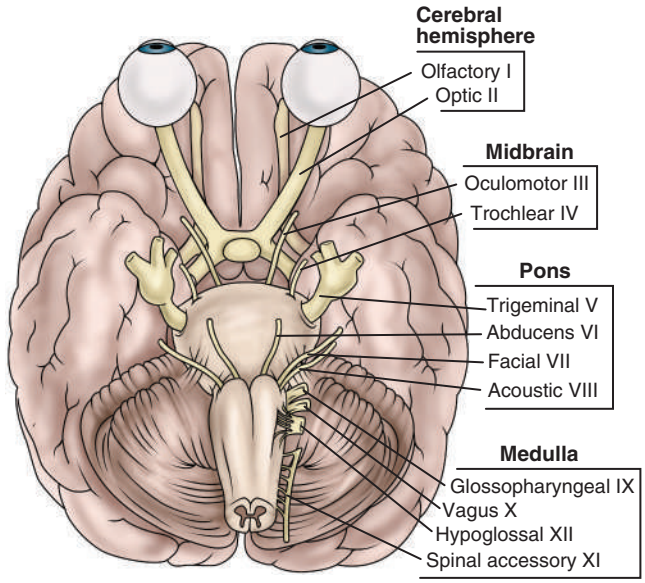


Figure 48-8 • Diagram of the base of the brain showing location of the cranial nerves.

TABLE 48-2 Cranial Nerves

Cranial Nerve	Type	Function
I (olfactory)	Sensory	Sense of smell
II (optic)	Sensory	Visual acuity and visual fields
III (oculomotor)	Motor	Muscles that move the eye and lid, pupillary constriction, lens accommodation
IV (trochlear)	Motor	Muscles that move the eye
V (trigeminal)	Mixed	Facial sensation, corneal reflex, mastication
VI (abducens)	Motor	Muscles that move the eye
VII (facial)	Mixed	Symmetry of facial expression and muscle movement in upper and lower face, salivation and tearing, taste, sensation in the ear
VIII (acoustic)	Sensory	Hearing and equilibrium
IX (glossopharyngeal)	Mixed	Taste, sensation in pharynx and tongue, pharyngeal muscles, swallowing
X (vagus)	Mixed	Muscles of pharynx, larynx, and soft palate; sensation in external ear, pharynx, larynx, thoracic and abdominal viscera; parasympathetic innervation of thoracic and abdominal organs
XI (spinal accessory)	Motor	Sternocleidomastoid and trapezius muscles
XII (hypoglossal)	Motor	Movement of the tongue

Adapted from Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

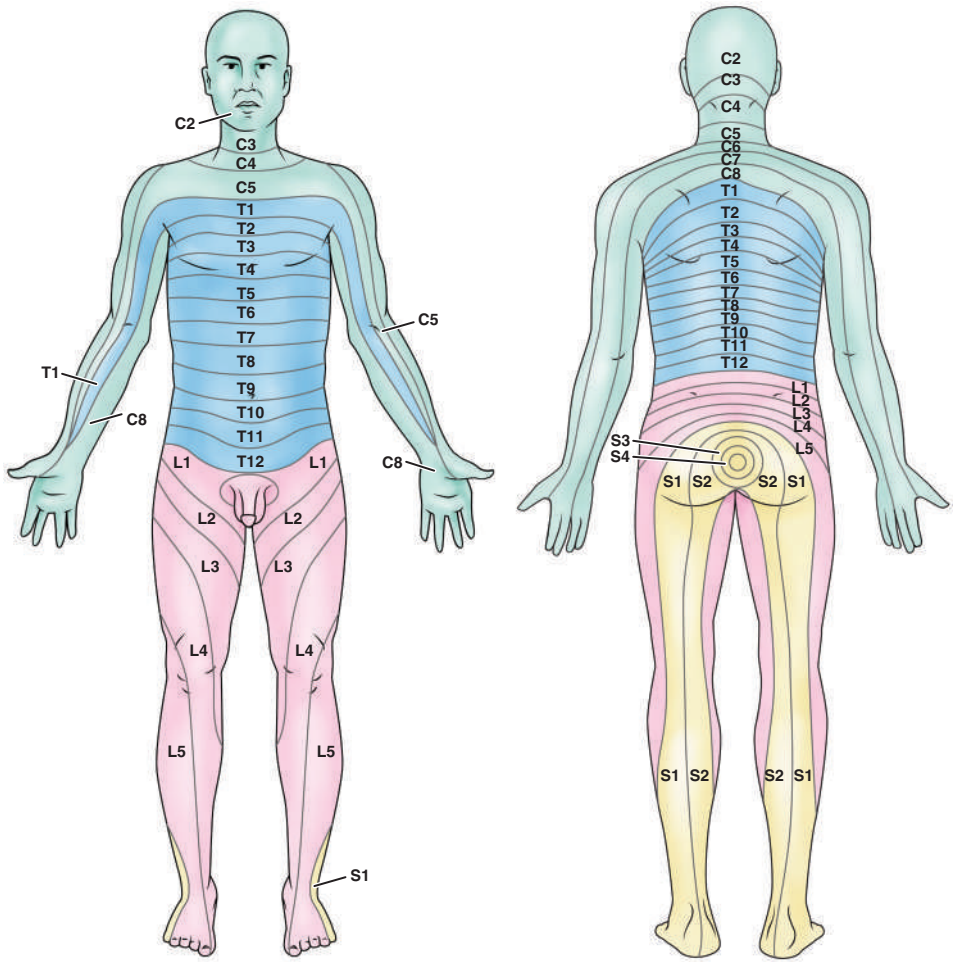


Figure 48-9 • Dermatome distribution.

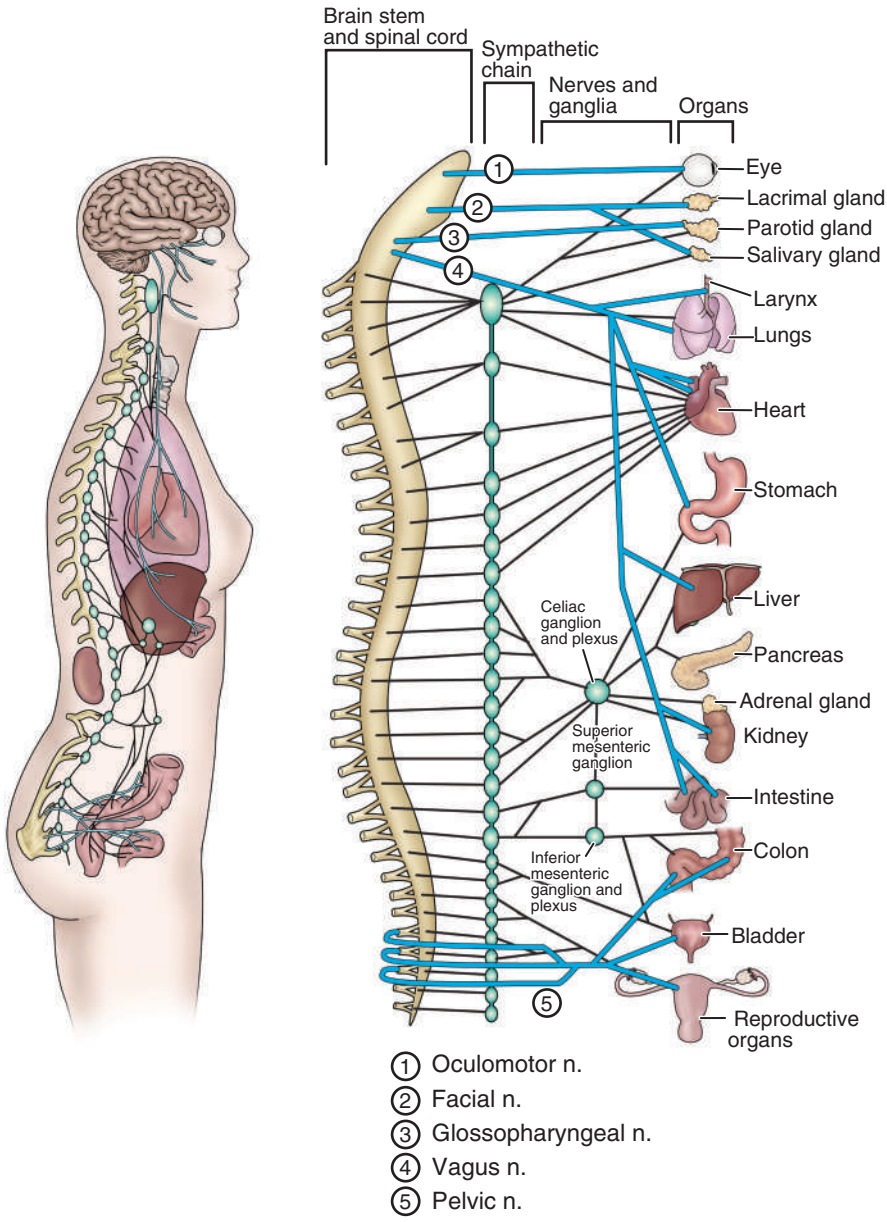


Figure 48-10 • Anatomy of the autonomic nervous system.

the sympathetic nervous system, with predominantly excitatory responses (most notably the "fight-or-flight" response), and the parasympathetic nervous system, which controls mostly visceral functions.

The autonomic nervous system innervates most body organs. Although usually considered part of the peripheral nervous system, this system is regulated by centers in the spinal cord, brain stem, and hypothalamus.

The hypothalamus is the major subcortical center for the regulation of autonomic activities, serving an inhibitory–excitatory role. The hypothalamus has connections that link the autonomic system with the thalamus, the cortex, the olfactory apparatus, and the pituitary gland. Located here are the mechanisms for the control of visceral and somatic reactions that were originally important for defense or attack and are associated with emotional states (e.g., fear, anger, and anxiety); for the control of metabolic processes, including fat, carbohydrate, and water metabolism; for the regulation of body temperature, arterial pressure, and all muscular and glandular activities of the gastrointestinal tract; for control of genital functions; and for the sleep cycle.

The autonomic nervous system is separated into the anatomically and functionally distinct sympathetic and parasympathetic divisions. Most of the tissues and the organs under autonomic control are innervated by both systems. For example, the parasympathetic division causes contraction (stimulation) of the urinary bladder muscles and a decrease (inhibition) in heart rate, whereas the sympathetic division produces relaxation (inhibition) of the urinary bladder and an increase (stimulation) in the rate and force of the heartbeat. Table 48-3 compares the sympathetic and the parasympathetic effects on the different systems of the body.

Sympathetic Nervous System

The sympathetic division of the autonomic nervous system is best known for its role in the body's fight-or-flight response. Under stress from either physical or emotional causes, sympathetic

TABLE 48-3 Effects of the Autonomic Nervous System

Structure or Activity	Parasympathetic Effects	Sympathetic Effects
Pupil of the Eye	Constricted	Dilated
Circulatory System		
Rate and force of heartbeat	Decreased	Increased
Blood vessels		
In heart muscle	Constricted	Dilated
In skeletal muscle	[a]	Dilated
In abdominal viscera and the skin	[a]	Constricted
Blood pressure	Decreased	Increased
Respiratory System		
Bronchioles	Constricted	Dilated
Rate of breathing	Decreased	Increased
Digestive System		
Peristaltic movements of digestive tube	Increased	Decreased
Muscular sphincters of digestive tube	Relaxed	Contracted
Secretion of salivary glands	Thin, watery saliva	Thick, viscid saliva
Secretions of stomach, intestine, and pancreas	Increased	[a]
Conversion of liver glycogen to glucose	[a]	Increased
Genitourinary System		
Urinary bladder		
Muscle walls	Contracted	Relaxed
Sphincters	Relaxed	Contracted
Muscles of the uterus	Relaxed; variable	Contracted under some conditions; varies with menstrual cycle and pregnancy
Blood vessels of external genitalia	Dilated	[a]
Integumentary System		
Secretion of sweat	[a]	Increased
Pilomotor muscles	[a]	Contracted (goose flesh)
Adrenal Medulla	[a]	Secretion of epinephrine and norepinephrine

[a]No direct effect.

Adapted from Hickey, J. (2014). Clinical practice of neurological and neurosurgical nursing (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

impulses increase greatly. As a result, the bronchioles dilate for easier gas exchange; the heart's contractions are stronger and faster; the arteries to the heart and voluntary muscles dilate, carrying more blood to these organs; peripheral blood vessels constrict, making the skin feel cool but shunting blood to essential organs; the pupils dilate; the liver releases glucose for quick energy; peristalsis slows; hair stands on end; and perspiration increases. The main sympathetic neurotransmitter is norepinephrine (noradrenaline). A sympathetic discharge releases epinephrine (adrenalin)—hence, the term *adrenergic* is often used to refer to this division.

Sympathetic neurons are located primarily in the thoracic and lumbar segments of the spinal cord, and their axons, or the preganglionic fibers, emerge by way of anterior nerve roots from the eighth cervical or first thoracic segment to the second or third lumbar segment. A short distance from the cord, these fibers diverge to join a chain, composed of 22 linked ganglia, that extends the entire length of the spinal column, adjacent to the vertebral bodies on both sides. Some form multiple synapses with nerve cells within the chain. Others traverse the chain without making connections or losing continuity to join large "prevertebral" ganglia in the thorax, the abdomen, or the pelvis or one of the "terminal" ganglia in the vicinity of an organ, such as the bladder or the rectum at the end of the colon (see Fig. 48-10). Postganglionic nerve fibers originating in the sympathetic chain rejoin the spinal nerves that supply the extremities and are distributed to blood vessels, sweat glands, and smooth muscle tissue in the skin. Postganglionic fibers from the prevertebral plexuses (e.g., the cardiac, pulmonary, splanchnic, and pelvic plexuses) supply structures in the head and neck, thorax, abdomen, and pelvis, respectively, having been joined in these plexuses by fibers from the parasympathetic division.

The adrenal glands, kidneys, liver, spleen, stomach, and duodenum are under the control of the giant celiac plexus, commonly known as the solar plexus. This receives its sympathetic nerve components by way of the three splanchnic nerves, composed of preganglionic fibers from nine segments of the spinal cord (T4 to L1), and is joined by the vagus nerve, representing the parasympathetic division. From the celiac plexus, fibers of both divisions travel along the course of blood vessels to their target organs.

Certain syndromes are distinctive to the sympathetic nervous system. For example, sympathetic storm is a syndrome associated with changes in level of consciousness, altered vital signs, diaphoresis, and agitation that may result from hypothalamic stimulation of the sympathetic nervous system following traumatic brain injury (Fischbach & Dunning, 2015).

Parasympathetic Nervous System

The parasympathetic nervous system functions as the dominant controller for most visceral functions; the primary neurotransmitter is acetylcholine. During quiet, nonstressful conditions, impulses from parasympathetic fibers (cholinergic) predominate. The fibers of the parasympathetic system are located in two sections: one in the brain stem and the other from spinal segments below L2. Because of the location of these fibers, the parasympathetic system is referred to as the craniosacral division, as distinct from the thoracolumbar (sympathetic) division of the autonomic nervous system.

The parasympathetic nerves arise from the midbrain and the medulla oblongata. Fibers from cells in the midbrain travel with the third oculomotor nerve to the ciliary ganglia, where postganglionic fibers of this division are joined by those of the sympathetic system, creating controlled opposition, with a delicate balance maintained between the two at all times.

Motor and Sensory Pathways of the Nervous System

Motor Pathways

The corticospinal tract begins in the motor cortex, a vertical band within each frontal lobe, and controls voluntary movements of the body. The exact locations within the brain at which the voluntary movements of the muscles of the face,

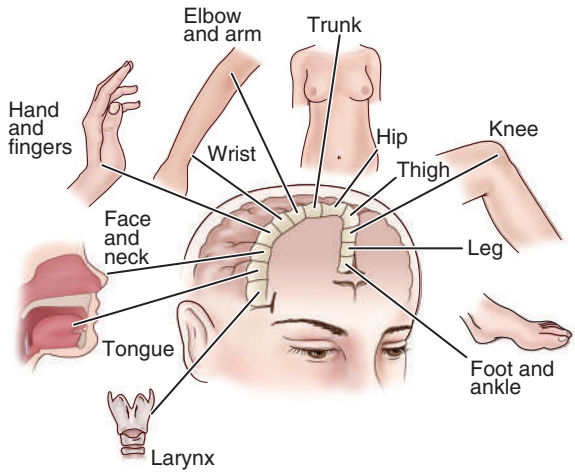


Figure 48-11 • Diagrammatic representation of the cerebrum showing locations for control of motor movement of various parts of the body.

thumb, hand, arm, trunk, and leg originate are known (see Fig. 48-11). To initiate movement, these particular cells must send the stimulus along their fibers. Stimulation of these cells with an electric current also results in muscle contraction. En route to the pons, the motor fibers converge into a tight bundle known as the internal capsule. A comparatively small injury to the internal capsule results in a more severe paralysis than does a larger injury to the cortex itself.

At the medulla, the corticospinal tracts cross to the opposite side, continuing to the anterior horn of the spinal cord, in proximity to a motor nerve cell. Until this point, neurons are known as upper motor neurons. As they connect to motor fibers of the spinal nerves, they become lower motor neurons. The lower motor neurons receive the impulse in the posterior part of the cord and run to the myoneural junction located in the peripheral muscle.

Involuntary motor activity is also possible and is mediated through reflex arcs. Synaptic connections between anterior horn cells and sensory fibers that have entered adjacent or neighboring segments of the spinal cord serve as protective mechanisms. These connections are seen during deep tendon reflex testing.

Upper and Lower Motor Neurons

The voluntary motor system consists of two groups of neurons: upper motor neurons and lower motor neurons. Upper motor neurons originate in the cerebral cortex, the cerebellum, and the brain stem. Their fibers make up the descending motor pathways, are located entirely within the CNS, and modulate the activity of the lower motor neurons. Lower motor neurons are located either in the anterior horn of the spinal cord gray matter or within cranial nerve nuclei in the brain stem. Axons of lower motor neurons in both sites extend through peripheral nerves and terminate in skeletal muscle. Lower motor neurons are located in both the CNS and the peripheral nervous system.

The motor pathways from the brain to the spinal cord, as well as from the cerebrum to the brain stem, are formed by upper motor neurons. They begin in the cortex of one side of the brain, descend through the internal capsule, cross to the opposite side in the brain stem, descend through the corticospinal tract, and synapse with the lower motor neurons in the cord. The lower motor neurons receive the impulse in the posterior part of the cord and run to the myoneural junction located in the peripheral muscle. The clinical features of lesions of upper and lower motor neurons are discussed in the following sections and in Table 48-4.

TABLE 48-4 Comparison of Upper Motor Neuron and Lower Motor Neuron Lesions

Upper Motor Neuron Lesions	Lower Motor Neuron Lesions
Loss of voluntary control	Loss of voluntary control
Increased muscle tone	Decreased muscle tone
Muscle spasticity	Flaccid muscle paralysis
No muscle atrophy	Muscle atrophy
Hyperactive and abnormal reflexes	Absent or decreased reflexes

Upper motor neuron lesions

Upper motor neuron lesions can involve the motor cortex, the internal capsule, the spinal cord gray matter, and other structures of the brain through which the corticospinal tract descends. If the upper motor neurons are damaged or destroyed, as frequently occur with stroke or spinal cord injury, paralysis (loss of voluntary movement) results. However, because the inhibitory influences of intact upper motor neurons are impaired, reflex (involuntary) movements are uninhibited, and hence hyperactive deep tendon reflexes, diminished or absent superficial reflexes, and pathologic reflexes such as a Babinski response occur. Severe leg spasms can occur as the result of an upper motor neuron lesion; the spasms result from the preserved reflex arc, which lacks inhibition along the spinal cord below the level of injury. There is little or no muscle atrophy, and muscles remain permanently tense, exhibiting spastic paralysis.

Paralysis associated with upper motor neuron lesions can affect a whole extremity, both extremities, or an entire half of the body. *Hemiplegia* (paralysis of an arm and leg on the same side of the body) can be the result of an upper motor neuron lesion. If hemorrhage, an embolus, or a thrombus destroys the fibers from the motor area in the internal capsule, the arm and the leg of the opposite side become stiff, weak, or paralyzed, and the reflexes are hyperactive (see further discussion of hemiplegia in Chapter 50). If both legs are paralyzed, the condition is called *paraplegia*. If all four extremities are paralyzed, the condition is called *tetraplegia* (quadriplegia).

Lower motor neuron lesions

A patient is considered to have lower motor neuron damage if a motor nerve is damaged between the spinal cord and muscle. The result of lower motor neuron damage is muscle paralysis. Reflexes are lost, and the muscle becomes flaccid (limp) and atrophied from disuse. If the patient has injured the spinal trunk and it can heal, the use of muscles connected to that section of the spinal cord may be regained. However, if the anterior horn motor cells are destroyed, the nerves cannot regenerate and the muscles are never useful again.

Flaccid paralysis and atrophy of the affected muscles are the principal signs of lower motor neuron disease. Lower motor neuron lesions can be the result of trauma, infection (poliomyelitis), toxins, vascular disorders, congenital malformations, degenerative processes, and neoplasms. Compression of nerve roots by herniated intervertebral discs is a common cause of lower motor neuron dysfunction.

Coordination of Movement

The motor system is complex, and motor function depends not only on the integrity of the corticospinal tracts but also on other pathways from the basal ganglia and cerebellum that control and coordinate voluntary motor function. The smoothness, accuracy, and strength that characterize the muscular movements of a normal person are attributable to the influence of the cerebellum and the basal ganglia.

Through the action of the cerebellum, the contractions of opposing muscle groups are adjusted in relation to each other to maximal mechanical advantage; muscle contractions can be sustained evenly at the desired tension and without significant fluctuation, and reciprocal movements can be reproduced at high and constant speed, in stereotyped fashion and with relatively little effort.

The basal ganglia play an important role in planning and coordinating motor movements and posture. Complex neural connections link the basal ganglia with the cerebral cortex. The major effect of these structures is to inhibit unwanted muscular activity.

Impaired cerebellar function, which may occur as a result of an intracranial injury or some type of an expanding mass (e.g., a hemorrhage, an abscess, or a tumor), results in loss of muscle tone, weakness, and fatigue. Depending on the area of the brain affected, the patient has different motor symptoms or responses. The patient may demonstrate abnormal flexion, abnormal extension, or flaccid posturing. Flaccidity (lack of muscle tone) preceded by abnormal posturing in a patient with cerebral injury indicates severe neurologic impairment, which may herald brain death (Klein & Stewart-Amidei, 2012); (Posner, Saper, Schiff, et al., 2007). See Figure 49-2 in Chapter 49 for further explanation of posturing.

Destruction or dysfunction of the basal ganglia leads not to paralysis but to muscle rigidity, disturbances of posture, and difficulty initiating or changing movement. The patient tends to have involuntary movements. These may take the form of coarse tremors, most often in the upper extremities, particularly in the distal portions; athetosis, which is movement of a slow, squirming, writhing, twisting type; or chorea, marked by spasmodic, purposeless, irregular, uncoordinated motions of the trunk and the extremities, and facial grimacing. Disorders affecting basal ganglia activity include Parkinson and Huntington diseases (see Chapter 53).

Sensory System Function

Receiving Sensory Impulses

Afferent impulses travel from their points of origin to their destinations in the cerebral cortex via the ascending pathways directly, or they may cross at the level of the spinal cord or in the medulla, depending on the type of sensation carried. Knowledge of these pathways is important for neurologic assessment and for understanding symptoms and their relationship to various lesions.

Sensory impulses convey sensations of heat, cold, and pain; position; and vibration. The axons enter the spinal cord by way of the posterior root, specifically in the posterior gray columns of the spinal cord, where they connect with the cells of secondary neurons. Pain and temperature fibers (located in the spinothalamic tract) cross immediately to the opposite side of the cord and course upward to the thalamus. Fibers carrying sensations of touch, light pressure, and localization do not connect immediately with the second neuron but ascend the cord for a variable distance before entering the gray matter and completing this connection. The axon of the secondary neuron traverses the cord, crosses in the medulla, and proceeds upward to the thalamus.

Position and vibratory sensations are produced by stimuli arising from muscles, joints, and bones. These stimuli are conveyed, uncrossed, all the way to the brain stem by the axon of the primary neuron. In the medulla, synaptic connections are made with cells of the secondary neurons, whose axons cross to the opposite side and then proceed to the thalamus.

Integrating Sensory Impulses

The thalamus integrates all sensory impulses except olfaction. It plays a role in the conscious awareness of pain and the recognition of variation in temperature and touch. The thalamus is responsible for the sense of movement and position as well as the ability to recognize the size, shape, and quality of objects. Sensory information is relayed from the thalamus to the parietal lobe for interpretation.

Sensory Losses

Destruction of a sensory nerve results in total loss of sensation in its area of distribution (see Fig. 48-9). Lesions affecting the posterior spinal nerve roots may impair tactile sensation, causing intermittent severe pain that is referred to their areas of distribution. Destruction of the spinal cord yields complete anesthesia below the level of injury. Selective destruction or degeneration of the posterior columns of the spinal cord is responsible for a loss of position and vibratory sense in segments distal to the lesion, without loss of touch, pain, or temperature perception. A cyst in the center of the spinal cord causes dissociation of sensation—loss of pain at the level of the lesion. This occurs because the fibers carrying pain and temperature cross within the cord immediately on entering; thus, any lesion that divides the cord longitudinally divides these fibers. Other sensory fibers ascend the cord for variable distances, some even to the medulla, before crossing, thereby bypassing the lesion and avoiding destruction. Lesions in the thalamus or parietal lobe result in impaired touch, pain, temperature, and proprioceptive sensations.

Assessment of the Nervous System

Health History

An important aspect of the neurologic assessment is the history of the present illness. The initial interview provides an excellent opportunity to systematically explore the patient's current condition and related events while simultaneously observing overall appearance, mental status, posture, movement, and affect. Depending on the patient's condition, the nurse may need to rely on yes-or-no answers to questions, a review of the medical record, input from witnesses or the family, or a combination of these.

Neurologic disorders may be stable or progressive, characterized by symptom-free periods as well as fluctuations in symptoms. The health history therefore includes details about the onset, character, severity, location, duration, and frequency of symptoms and signs; associated complaints; precipitating, aggravating, and relieving factors; progression, remission, and exacerbation; and the presence or absence of similar symptoms among family members.

Common Symptoms

The symptoms of neurologic disorders are as varied as the disease processes. Symptoms may be subtle or intense,

fluctuating or permanent, inconvenient or devastating. This chapter discusses the most common signs and symptoms associated with neurologic disease; the relationship of specific signs and symptoms to a particular disorder is presented in later chapters in this unit.

Pain

Pain is considered an unpleasant sensory perception and emotional experience associated with actual or potential tissue damage or described in terms of such damage. Pain is therefore considered multidimensional and entirely subjective. Pain can be acute or chronic. In general, acute pain lasts for a relatively short period of time and remits as the pathology resolves. In neurologic disease, acute pain may be associated with brain hemorrhage, spinal disc disease (Jarvis, 2015), or trigeminal neuralgia. In contrast, chronic or persistent pain extends for long periods of time and may represent a broader pathology. This type of pain can occur with many degenerative and chronic neurologic conditions (e.g., multiple sclerosis). See Chapter 9 for a more detailed discussion of pain.

Seizures

Seizures are the result of abnormal electrical discharges in the cerebral cortex, which then manifest as an alteration in sensation, behavior, movement, perception, or consciousness. The alteration may be short, such as in a blank stare that lasts only a second, or of longer duration, such as a tonic–clonic grand mal seizure that can last several minutes. The seizure activity reflects the area of the brain affected. Seizures can occur as isolated events, such as when induced by a high fever, alcohol or drug withdrawal, or hypoglycemia. A seizure may also be the first obvious sign of a brain lesion (Hickey, 2014).

Dizziness and Vertigo

Dizziness is an abnormal sensation of imbalance or movement. It is fairly common in the older adult and a common complaint encountered by health professionals (Jarvis, 2015). Dizziness can have a variety of causes, including viral syndromes, hot weather, roller-coaster rides, and middle ear infections, to name a few. One difficulty confronting health care providers when assessing dizziness is the vague and varied terms that patients use to describe the sensation.

About 50% of all patients with dizziness have vertigo, or the illusion of movement in which the individual or the surroundings are sensed as moving, usually as rotation (Jarvis, 2015). Vertigo is usually a manifestation of vestibular dysfunction. It can be so severe as to result in spatial disorientation, lightheadedness, loss of equilibrium (staggering), and nausea and vomiting.

Visual Disturbances

Visual defects that cause people to seek health care can range from the decreased visual acuity associated with aging to sudden blindness caused by glaucoma. Normal vision depends on functioning visual pathways through the retina and optic chiasm and the radiations into the visual cortex in the occipital lobes. Lesions of the eye itself (e.g., cataract), lesions along the pathway (e.g., tumor), or lesions in the visual cortex (e.g., stroke) interfere with normal visual acuity. Abnormalities of eye movement (as in the nystagmus associated with multiple sclerosis) can also compromise vision by causing diplopia or double vision. See Chapter 42 for a more detailed discussion of disorders that affect vision.

Muscle Weakness

Muscle weakness is a common manifestation of neurologic disease. It frequently coexists with other symptoms of disease and can affect a variety of muscles, causing a wide range of disability. Weakness can be sudden and permanent, as in stroke, or progressive, as in neuromuscular diseases such as amyotrophic lateral sclerosis. Any muscle group can be affected.

Abnormal Sensation

Abnormal sensation is a neurologic manifestation of both central and peripheral nervous system disease. Altered sensation can affect small or large areas of the body. It is frequently associated with weakness or pain and is potentially disabling. Lack of sensation places a person at risk for falls and injury.

Past Health, Family, and Social History

The nurse may inquire about any family history of genetic diseases (see Chart 48-1). A review of the medical history, including a system-by-system evaluation, is part of the health history. The nurse should be aware of any history of trauma or falls that may have involved the head or spinal cord. Questions regarding the use of alcohol, medications, and illicit drugs are also relevant. The history-taking portion of the neurologic assessment is critical and, in many cases of neurologic disease, leads to an accurate diagnosis.

Physical Assessment

The neurologic examination is a systematic process that includes a variety of clinical tests, observations, and assessments designed to evaluate the neurologic status of a complex system. Many neurologic rating scales exist (Herndon, 2006), and some of the more common ones are discussed in this chapter.

The brain and spinal cord cannot be examined as directly as other systems of the body. Therefore, much of the neurologic examination is an indirect evaluation that assesses the function of the specific body part or parts controlled by the nervous system. A neurologic assessment is divided into five components: consciousness and cognition, cranial nerves, motor system, sensory system, and reflexes. One or more components may become the priority assessment, depending on the patient's condition. For example, motor, sensory, and reflex assessments are the priority in patients with spinal injury, whereas in a patient who is comatose, the cranial nerves and level of consciousness become the priority.

Assessing Consciousness and Cognition

Cerebral abnormalities may cause disturbances in mental status, intellectual functioning, thought content, and emotional status. There may also be alterations in language abilities as well as lifestyle. The examiner must also be aware of the patient's overall level of consciousness and any changes over time (Posner et al., 2007).

The examiner records and reports specific observations regarding mental status, intellectual function, thought content, and emotional status, all of which permit comparison by others over time. Alterations should be described in specific and nonjudgmental terms. The use of terms such as "inappropriate" or "demented" is avoided, because they often mean different things to different people and are therefore not useful when describing behavior. Analysis and the conclusions that may be drawn from these findings usually depend on the examiner's knowledge of neuroanatomy, neurophysiology, and neuropathology.

Chart 48-1 GENETICS IN NURSING PRACTICE

Neurologic Disorders

Several neurologic disorders are associated with genetic abnormalities. Neurologic impairment is noted with many other genetic illnesses. Some examples include:

Autosomal Dominant:

- Cerebral arteriopathy
- Familial Alzheimer disease
- Huntington disease
- Myotonic dystrophies
- Neurofibromatosis
- Von Hippel–Lindau syndrome

Autosomal Recessive:

- Canavan disease
- Familial dysautonomia
- Friedreich's ataxia

X Linked:

- Duchenne muscular dystrophy
- Fragile X syndrome

Inheritance pattern is not distinct; however, there is a genetic predisposition for the disease:

- Amyotrophic lateral sclerosis (ALS)
- Epilepsy
- Neural tube defects (e.g., spina bifida, anencephaly)
- Parkinson disease
- Tourette syndrome

Other genetic disorders that also impact the neurologic system:

- Bipolar disease
- Downs syndrome
- Phenylketonuria (PKU)
- Schizophrenia
- Tay–Sachs disease
- Tuberous sclerosis complex

Nursing Assessments

Family History Assessment Specific to Neurologic Disorders

- Assess for other similarly affected relatives with neurologic impairment.
- Inquire about age of onset (e.g., present at birth—spina bifida; developed in childhood—Duchenne muscular dystrophy; developed in adulthood—Huntington disease, Alzheimer disease, ALS).
- Inquire about the presence of related conditions such as intellectual disability and/or learning disabilities (neurofibromatosis type 1).

Patient Assessment

- Assess for the presence of other physical features suggestive of an underlying genetic condition, such as skin lesions seen in neurofibromatosis (café au lait spots).
- Assess attention span, and the presence of hyperactivity or withdrawn behavior.
- Assess for other congenital abnormalities (e.g., cardiac, ocular).
- Inspect for presence of freckles in the axillary or inguinal areas.
- Assess for presence of uncoordinated movement of extremities, muscle twitching, or history of seizures.
- Assess for poor or hyperactive muscle tone.
- Assess for episodes of forgetfulness or uncharacteristic changes in behavior or mood.
- Inspect for disproportionate facial features (fragile X or Downs syndrome).
- Observe for presence of "tics" or uncontrolled body movement.
- Ask about history of seizures or head trauma.

Genetics Resources

Epilepsy Foundation, www.epilepsy.com/learn/diagnosis/genetic-testing
Huntington's Disease Society of America, hdsa.org/what-is-hd/#genetic
Muscular Dystrophy Association, www.mda.org

Mental Status

An assessment of mental status begins by observing the patient's appearance and behavior, noting dress, grooming, and personal hygiene. Posture, gestures, movements, and facial expressions often provide important information about the patient. Does the patient appear to be aware of and interact with the surroundings?

Assessing orientation to time, place, and person assists in evaluating mental status. Does the patient know what day it is, what year it is, and the name of the Prime Minister of India? Is the patient aware of where he or she is? Is the patient aware of who the examiner is and of their purpose for being in the room? Assessment of immediate and remote memory is also important. Is the capacity for immediate memory intact? See Chapter 62.

Intellectual Function

A person with an average intelligence quotient (IQ) can repeat seven digits without faltering and can recite five digits backward. The examiner might ask the patient to count backward from 100 or to subtract 7 from 100, then 7 from that, and so forth (referred to as serial 7s). The capacity to interpret well-known proverbs tests abstract reasoning, which is a higher intellectual function—for example, does the patient know what is meant by "a stitch in time saves nine"? The intellectual function of patients with damage to the frontal cortex appears intact until one or more tests of intellectual capacity are performed. Questions designed to assess this capacity might include the ability to recognize similarities—for example, how are a mouse and dog or pen and pencil alike? Can the patient make judgments about situations—for example, if the patient arrives home without a house key, what alternatives are there?

Thought Content

During the interview, it is important to assess the patient's thought content. Are the patient's thoughts spontaneous, natural, clear, relevant, and coherent? Does the patient have any fixed ideas, illusions, or preoccupations? What are their insights into these thoughts? Preoccupation with death or morbid events, hallucinations, and paranoid ideation are examples of unusual thoughts or perceptions that require further evaluation.

Emotional Status

An assessment of consciousness and cognition also includes the patient's emotional status. Is the patient's affect (external manifestation of mood) natural and even, or irritable and angry, anxious, apathetic or flat, or euphoric? Does their mood fluctuate normally, or does the patient unpredictably swing from joy to sadness during the interview? Is affect appropriate to words and thought content? Are verbal communications consistent with nonverbal cues?

Language Ability

The person with normal neurologic function can understand and communicate in spoken and written language. Does the patient answer questions appropriately? Can he or she read a sentence from a newspaper and explain its meaning? Can the patient write their name or copy a simple figure that the examiner has drawn? A deficiency in language function is called *aphasia*. Different types of aphasia result from injury to different parts of the brain (see Table 48-5). See Chapter 50 for a detailed discussion of aphasia.

Impact on Lifestyle

The nurse assesses the impact of any impairment on the patient's lifestyle. Issues to consider include the limitations imposed on the patient by any cognitive deficit and the patient's role in society, including family and community roles. The plan of care that the nurse develops needs to address and support adaptation to the neurologic deficit and continued function to the extent possible within the patient's support system.

Level of Consciousness

Consciousness is the patient's wakefulness and ability to respond to the environment. Level of consciousness is the most sensitive indicator of neurologic function. To assess level of consciousness, the examiner observes for alertness and ability to follow commands.

If the patient is not alert or able to follow commands, the examiner observes for eye opening; verbal response and motor response to stimuli, if any; and the type of stimuli needed to obtain a response. Noxious stimuli should be used first, then painful stimuli if no response is observed. In the patient with decreased level of consciousness, motor and cranial nerve functions become the priority assessments, because abnormalities can indicate the area of involvement in the absence of responsiveness. See Chapter 49 for further discussion of changes in level of consciousness.

Examining the Cranial Nerves

Cranial nerves are assessed when level of consciousness is decreased, with brain stem pathology, or in the presence of peripheral nervous system disease (Weber & Kelley, 2014). Right and left cranial nerve functions are compared throughout the examination.

For the procedural guidelines for assessing cranial nerve function, refer to Procedural Guidelines 48-1.

Examining the Motor System

Motor Ability

A thorough examination of the motor system includes an assessment of muscle size and tone as well as strength, coordination, and balance. The patient is instructed to walk across the room, if possible, while the examiner observes posture and gait. The muscles are inspected, and palpated if necessary, for their size and symmetry. Any evidence of atrophy or involuntary movements (tremors, tics) is noted. Muscle tone (the tension present in a muscle at rest) is evaluated by palpating various muscle groups at rest and during passive movement. Resistance to these movements is assessed and documented. Abnormalities in tone include spasticity (increased muscle tone), rigidity (resistance to passive stretch), and flaccidity.

TABLE 48-5 Types of Aphasia and Region of Brain Involved

Type of Aphasia	Brain Area Involved
Auditory receptive	Temporal lobe
Visual receptive	Parietal and occipital area
Expressive speaking	Inferior-posterior frontal areas
Expressive writing	Posterior frontal area

Muscle Strength

Assessing the patient's ability to flex or extend the extremities against resistance tests muscle strength. The function of an individual muscle or group of muscles is evaluated by placing the muscle at a disadvantage. The quadriceps, for example, is a powerful muscle responsible for straightening the leg. Once the leg is straightened, it is exceedingly difficult for the examiner to flex the knee. If the knee is flexed and the patient is asked to straighten the leg against resistance, weakness can be elicited. The evaluation of muscle strength compares the sides of the body to each other. For example, the right upper extremity is compared to the left upper extremity. Subtle differences in strength may be evaluated by testing for drift. For example, both arms are out in front of the patient with palms up; drift is seen as pronation of the palm, indicating a subtle weakness that may not have been detected on the resistance examination.

Clinicians use a five-point scale to rate muscle strength. A 5 indicates full power of contraction against gravity and resistance or normal muscle strength; 4 indicates fair but not full strength against gravity and a moderate amount of resistance or slight weakness; 3 indicates just sufficient strength to overcome the force of gravity or moderate weakness; 2 indicates the ability to move but not to overcome the force of gravity or severe weakness; 1 indicates minimal contractile power (weak muscle contraction can be palpated but no movement is noted) or very severe weakness; and 0 indicates no movement (Jarvis, 2015).

Nursing Alert: When recording muscle strength, a stick figure is used as a precise form to document findings. The five-point scale is used to rate and record distal and proximal strength in both upper and lower extremities. Figure 48-12 provides further details.

Assessment of muscle strength may be as detailed as necessary. One may quickly test the strength of the proximal muscles of the upper and lower extremities, always assessing both sides by comparing one side to the other. The strength of the finer muscles that control the function of the hand (hand grasp) and the foot (dorsiflexion and plantar flexion) can then be assessed.

Balance and Coordination

Cerebellar and basal ganglia influence on the motor system is reflected in balance control and coordination. Coordination in the hands and upper extremities is tested by having the patient perform rapid, alternating movements and point-to-point testing. First, the patient is instructed to pat their thigh as fast as possible with each hand separately. Then, the patient is instructed to alternately pronate and supinate the hand as rapidly as possible. Last, the patient is asked to touch each of the fingers with the thumb in a consecutive motion. Speed, symmetry, and degree of difficulty are noted. Point-to-point testing is accomplished by having the patient touch the

Procedural Guidelines 48-1

Nursing Procedure for Assessing Cranial Nerve Function

Equipment

- Tongue depressor
- Flashlight
- Sugar and salt samples
- Watch
- Cotton-tipped swab
- Cotton swabs
- Snellen chart
- Ophthalmoscope
- Samples of familiar odors
- Tuning fork
- Tubes of hot and cold water

Implementation

Nursing Actions	Rationale
1. Explain procedure to patient.	1. Knowledge increases patient comfort and cooperation.
2. Perform hand hygiene.	2. Asepsis is essential to prevent infection.
3. Assess cranial nerve (CN) I (olfactory). With eyes closed, patient is asked to identify familiar odors (coffee, tobacco). Each nostril is tested separately.	3. The significant finding is anosmia (loss of sense of smell).
4. Assess CN II (optic). Assess vision using a Snellen eye chart. Assess visual fields. Perform ophthalmoscopic examination.	4. Significant findings include hemianopias (visual field defects) and decreased visual acuity or blindness.
5. Assess CN III (oculomotor). Test for eye movement toward the nose; inspect for conjugate movements and nystagmus. Evaluate papillary size, and test for pupillary reactivity to light; inspect ability to open eyelids.	5. Significant findings include dysconjugate gaze; gaze weakness or paralysis; double vision; dilated pupil, with or without impaired pupillary reaction to light; and inability to open the affected eyelid.
6. Assess CN IV (trochlear). Test for upward eye movement; inspect for conjugate movements and nystagmus.	6. Significant findings include dysconjugate gaze, gaze weakness or paralysis, and double vision.
7. Assess CN V (trigeminal). Have patient close the eyes. Touch cotton to forehead, cheeks, and jaw. Sensitivity to superficial pain is tested in these same three areas by using the sharp and dull ends of a broken tongue blade. Alternate between the sharp point and the dull end. Patient reports "sharp" or "dull" with each movement. If responses are incorrect, test for temperature sensation. Test tubes of cold and hot water are used alternately. While patient looks up, lightly touch a wisp of cotton against the temporal surface of each cornea. A blink and tearing are normal responses. Have patient clench and move the jaw from side to side. Palpate the masseter and temporal muscles, noting strength and equality.	7. Significant findings include impaired or absent corneal reflex, facial numbness, and jaw weakness.
8. Assess CN VI (abducens). Test for lateral eye movement; inspect for conjugate movement.	8. Significant findings include dysconjugate gaze, gaze weakness or paralysis, and double vision.
9. Assess CN VII (facial). Observe for symmetry while patient performs facial movements: smiles, whistles, elevates eyebrows, frowns, tightly closes eyelids against resistance (examiner attempts to open them). Observe face for flaccid paralysis (shallow nasolabial folds). Have patient extend tongue. Test ability to discriminate between sugar and salt.	9. Significant findings include facial weakness, inability to completely close the eyelid, and impaired taste.
10. Assess CN VIII (acoustic). Perform whisper or watch-tick test. Test for lateralization (Weber test). Test for air and bone conduction (Rinne test). Assess balance with eyes open and then closed for 20 seconds (Romberg test).	10. Significant findings include decreased hearing or deafness and impaired balance.
11. Assess CN IX (glossopharyngeal). Assess patient's ability to swallow and discriminate between sugar and salt on posterior third of the tongue.	11. Significant findings include dysphagia (difficulty swallowing) and impaired taste.
12. Assess CN X (vagus). Depress a tongue blade on posterior tongue, or stimulate posterior pharynx to elicit gag reflex. Note any hoarseness in voice. Check ability to swallow. Have patient say "ah." Observe for symmetric rise of uvula and soft palate.	12. Significant findings include weak or absent gag reflex, dysphagia, aspiration, hoarseness, and dysarthria (slurred speech).
13. Assess CN XI (spinal accessory). While patient shrugs shoulders against resistance, palpate and note strength of trapezius muscles. As patient turns head against opposing pressure of the examiner's hand, palpate and note strength of each sternocleidomastoid muscle.	13. Significant findings include weak or absent shoulder shrug and inability to turn the head to the side.
14. Assess CN XII (hypoglossal). While patient protrudes the tongue, note any deviation or tremors. Test the strength of the tongue by having patient move the protruded tongue from side to side against a tongue depressor.	14. Significant findings include dysphagia and dysarthria.

Adapted from Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses; Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

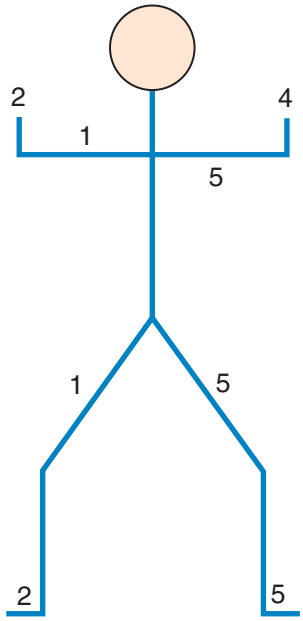


Figure 48-12 • A stick figure may be used to record muscle strength.

examiner's extended finger and then their own nose. This is repeated several times.

Coordination in the lower extremities is tested by having the patient run the heel down the anterior surface of the tibia of the other leg. Each leg is tested in turn. Ataxia is an incoordination of voluntary muscle action, particularly of the muscle groups used in activities such as walking or reaching for objects. Tremors (rhythmic, involuntary movements) noted at rest or during movement suggest a problem in the anatomic areas responsible for balance and coordination.

The Romberg test is a screening test for balance that can be done with the patient seated or standing. The patient can be seated or stand with feet together and arms at the side, first with eyes open and then with both eyes closed for 20 seconds (Bader, Littlejohns, & Olson, 2016); (Weber & Kelley, 2014). The examiner stands close to support the standing patient if he or she begins to fall. Slight swaying is normal, but a loss of balance is abnormal and is considered a positive Romberg test. Additional cerebellar tests for balance in the patient who is ambulatory include hopping in place, alternating knee bends, and heel-to-toe walking (both forward and backward).

Examining the Sensory System

The sensory system is even more complex than the motor system, because sensory modalities are more widespread throughout the central and peripheral nervous systems. The sensory examination is largely subjective and requires the cooperation of the patient. The examiner should be familiar with dermatomes that represent the distribution of the peripheral nerves that arise from the spinal cord (see Fig. 48-9) (Jarvis, 2015).

Assessment of the sensory system involves tests for tactile sensation, superficial pain, temperature, vibration, and position sense (proprioception). During the sensory assessment, the patient's eyes are closed. Simple directions and reassurance that the examiner will not hurt or startle the patient encourage the cooperation of the patient.

Tactile sensation is assessed by lightly touching a cotton wisp or fingertip to corresponding areas on each side of the body. The sensitivity of proximal parts of the extremities is compared with that of distal parts, and the right and left sides are compared.

Pain and temperature sensations are transmitted together in the lateral part of the spinal cord, so it is unnecessary to test for temperature sense in most circumstances. Determining the patient's sensitivity to a sharp object can assess superficial pain perception. However, pain sensation is usually reserved for patients who do not respond to or cannot discriminate touch stimulation. The patient is asked to differentiate between the sharp and dull ends of a broken wooden cotton swab or tongue blade; using a safety pin is inadvisable because it breaks the integrity of the skin. Both the sharp and dull sides of the object are applied with equal intensity at all times, and the two sides are compared. In the patient with an altered level of consciousness alternate methods of assessing pain may need to be used (see Chart 48-2) (Arbour, Gelinas, Loiselle, et al., 2015); (Poulsen, Brix, Andersen, et al., 2016).

Chart 48-2 NURSING RESEARCH PROFILE

BIS Monitoring for Pain Assessment

Arbour, C., Gelinas, C., Loiselle, C. G., et al. (2015). An exploratory study of the Bilateral Bispectral Index for pain detection in traumatic brain injured patients with altered level of consciousness. Journal of Neuroscience Nursing, 47(3), 166–177.

Purpose

The purpose of neurologic assessment is to identify alterations in neurologic function so that interventions may be implemented in a timely manner, but accurate assessment is not always possible in patients with an altered level of consciousness. This study sought to validate the bilateral bispectral index system (BIS) for pain assessment in patients with Traumatic Brain Injury (TBI) with an altered level of consciousness.

Design

The study used a repeated measure within-subject design utilizing a convenience sample of patients with TBI. Pain behaviors and BIS readings were observed during two procedures, one being noninvasive blood pressure monitoring the other during turning. Participants were observed for 1 minute before for a baseline, then during, and at 15 minutes after the two procedures.

Findings

The sample included 25 participants 18 years of age and older with Glasgow Coma Scores of 3 to 13 who were in ICU between 24 hours and 30 days. Stable BIS readings were found during the use of the noninvasive blood pressure monitoring. There was a significant increase in bilateral BIS from baseline during turning as well as an increase in observed pain behaviors (+3.00). However, only increased BIS readings recorded in the right hemisphere of the brain correlated with the pain behaviors of participants, those with a left-sided TBI.

Nursing Implications

More research is needed but nurses should know that there is potential for the use of bilateral BIS monitoring in the assessment of pain in patients who are nonverbal. This study provides beginning evidence that bilateral BIS has the potential for pain detection in those with a left-sided lesion.

Vibration and proprioception are transmitted together in the posterior part of the cord. Vibration may be evaluated through the use of a low-frequency (128 or 256 Hz) tuning fork. The handle of the vibrating fork is placed against a bony prominence, and the patient is asked if he or she feels a sensation and is instructed to signal the examiner when the sensation ceases. Common locations used to test for vibratory sense include the distal joint of the great toe and the proximal thumb joint. If the patient does not perceive the vibrations at the distal bony prominences, the examiner progresses upward with the tuning fork until the patient perceives the vibrations. As with all measurements of sensation, a side-to-side comparison is made.

Position sense or proprioception may be determined by asking the patient to close both eyes and indicate, as the great toe or index finger is alternately moved up and down, in which direction movement has taken place. Vibration and position sense are often lost together, frequently in circumstances in which all other sensation remains intact.

Integration of sensation in the brain is evaluated by testing two-point discrimination. When the patient is touched with two sharp objects simultaneously, are they perceived as two or as one? If touched simultaneously on opposite sides of the body, the patient should normally report being touched in two places. If only one site is reported, the one not being recognized is said to demonstrate extinction. Another test of higher cortical sensory ability is tactile identification. The patient is instructed to close both eyes and identify an object (e.g., key, coin) that is placed in one hand by the examiner; inability to identify an object by touch is known as tactile agnosia or astereognosis. Agnosia is the general loss of ability to recognize objects through a particular sensory system. The patient can also be shown a familiar object and asked to identify it by name; inability to identify a visualized object is known as visual agnosia. Each of these dysfunctions implicates a different part of the brain (see Table 48-6).

Decreased or absent sensations occur with problems anywhere along the sensory pathway. Sensory deficits resulting from peripheral neuropathy or spinal cord injury follow anatomic dermatomes. Destructive lesions of the brain may affect sensation on an entire side of the body. Stroke affecting a portion of the sensory cortex will produce altered sensory discrimination.

Examining the Reflexes

Reflexes are involuntary contractions of muscles or muscle groups in response to a stimulus. Reflexes are classified as deep tendon, superficial, or pathologic. Testing reflexes enables the examiner to assess involuntary reflex arcs that depend on the presence of afferent stretch receptors, spinal or brain stem synapses, efferent motor fibers, and a variety of modifying influences from higher levels.

Deep Tendon Reflexes

A reflex hammer is used to elicit a deep tendon reflex. The handle of the hammer is held loosely between the thumb and index finger, allowing a full swinging motion. The wrist motion is similar to that used during percussion. The extremity is positioned so that the tendon is slightly stretched. This requires a sound knowledge of the location of muscles and their tendon attachments. The tendon is then struck briskly (see Fig. 48-13), and the response is compared with that on the opposite side of the body. A wide variation in reflex response may be considered normal; however, it is more important that the reflexes be symmetrically equivalent. When the comparison is made, both sides should be equivalently relaxed and each tendon struck with equal force.

Valid findings depend on several factors: proper use of the reflex hammer, proper positioning of the extremity, and a patient who is relaxed (Jarvis, 2015). If the reflexes are symmetrically diminished or absent, the examiner may use isometric contraction of other muscle groups to increase reflex activity. For example, if lower extremity reflexes are diminished or absent, the patient is instructed to lock the fingers together and pull in opposite directions. Having the patient clench the jaw or press the heels against the floor or examining table may similarly elicit more reliable biceps, triceps, and brachioradialis reflexes.

The absence of reflexes is significant, although ankle jerks (Achilles reflex) may be normally absent in older adults. Deep tendon reflex responses are often graded on a scale of 0 to 4+, with 2+ considered normal (see Chart 48-3) but scale ratings are highly subjective. Findings can be recorded as a fraction, indicating the scale range (e.g., 2/4). Some examiners prefer to use the terms *present, absent,* and *diminished* when describing reflexes. As with muscle strength recording, a stick figure may be used to record numerical findings.

Biceps reflex

The biceps reflex is elicited by striking the biceps tendon over a slightly flexed elbow (see Fig. 48-13A). The examiner supports the forearm at the elbow with one arm while placing the thumb against the tendon and striking the thumb with the

TABLE 48-6 Types of Agnosia and Corresponding Sites of Lesions

Type of Aphasia	Brain Area Involved
Visual	Occipital lobe
Auditory	Temporal lobe (lateral and superior portions)
Tactile	Parietal lobe
Body parts and relationships	Parietal lobe (posteroinferior regions)

Chart 48-3

Documenting Reflexes

Deep tendon reflexes are graded on a scale of 0–4:

0 No response
1+ Diminished (hypoactive)
2+ Normal
3+ Increased (may be interpreted as normal)
4+ Hyperactive (hyperreflexia)

The deep tendon responses and plantar reflexes are commonly recorded on stick figures. The arrow points downward if the plantar response is normal and upward if the response is abnormal.

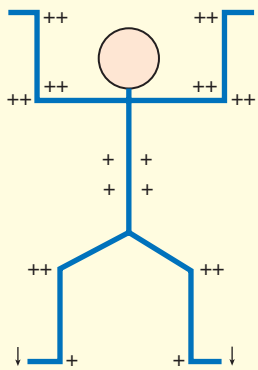




Figure 48-13 • Techniques for eliciting major reflexes. **A**. Eliciting the biceps reflex. **B**. Eliciting the triceps reflex. **C**. Eliciting the patellar reflex. **D**. Eliciting the Achilles reflex. Parts **A–D** from Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

reflex hammer. The normal response is flexion at the elbow and contraction of the biceps.

Triceps reflex

To elicit a triceps reflex, the patient's arm is flexed at the elbow and hanging freely at the side. The examiner supports the patient's arm and identifies the triceps tendon by palpating 2.5 to 5 cm (1 to 2 inches) above the elbow. A direct blow on the tendon (see Fig. 48-13B) normally produces contraction of the triceps muscle and extension of the elbow.

Brachioradialis reflex

With the patient's forearm resting on the lap or across the abdomen, the brachioradialis reflex is assessed. A gentle strike of the hammer 2.5 to 5 cm (1 to 2 inches) above the wrist results in flexion and supination of the forearm (Jarvis, 2015).

Patellar reflex

The patellar reflex is elicited by striking the patellar tendon just below the patella. The patient may be in a sitting or a lying position. If the patient is supine, the examiner supports the legs to facilitate relaxation of the muscles (see Fig. 48-13C). Contractions of the quadriceps and knee extension are normal responses.

Achilles reflex

To elicit an Achilles reflex, the foot is dorsiflexed at the ankle and the hammer strikes the stretched Achilles tendon (see Fig. 48-13D). This reflex normally produces plantar flexion. If the examiner cannot elicit the ankle reflex and suspects that the patient cannot relax, the patient is instructed to kneel on a chair or similar elevated, flat surface. This position places the ankles in dorsiflexion and reduces any muscle tension in the gastrocnemius. The Achilles tendons are struck in turn, and plantar flexion is usually demonstrated (Jarvis, 2015).

Clonus

When reflexes are hyperactive, a movement called clonus may be elicited. If the foot is abruptly dorsiflexed, it may continue to "beat" two or three times before it settles into a position of rest. Occasionally with CNS system disease, this activity persists, and the foot does not come to rest while the tendon is being stretched but persists in repetitive activity. The unsustained clonus associated with normal but hyperactive reflexes is not considered pathologic. Sustained clonus always indicates the presence of CNS disease and requires further evaluation.

Superficial Reflexes

The major superficial reflexes include corneal, palpebral, gag, upper/lower abdominal, cremasteric (men only), and perianal. These reflexes are graded differently than the motor reflexes and are noted to be present (+) or absent (–). Of these, only the corneal, gag, and plantar reflexes are commonly tested.

The corneal reflex is tested carefully using a clean wisp of cotton and lightly touching the outer corner of each eye on the sclera. The reflex is present if the action elicits a blink. A stroke or brain injury might result in loss of this reflex, either unilaterally or bilaterally. Loss of this reflex indicates the need for eye protection and possible lubrication to prevent corneal damage.

The gag reflex is elicited by gently touching the back of the pharynx with a cotton-tipped applicator, first on one side of the uvula and then the other. Positive response is an equal elevation of the uvula and "gag" with stimulation. Absent response on one or both sides can be seen following a stroke and requires careful evaluation and treatment of the resultant swallowing dysfunction to prevent aspiration of food and fluids.

Pathologic Reflexes

Pathologic reflexes are seen in the presence of neurologic disease; they often represent emergence of earlier reflexes that disappeared with maturity of the nervous system. A pathologic reflex indicative of CNS disease affecting the corticospinal tract is the Babinski reflex (sign). In a person with an intact CNS, if the lateral aspect of the sole of the foot is stroked, the toes contract and draw together. However, in a person who has CNS disease of the motor system, the toes fan out and draw back (Jarvis, 2015). This is normal in newborns but represents a serious abnormality in adults. Other pathologic reflexes include the suck (sucking motions in response to touching the lips), snout (lip pursing in response to touching the lips), palmar (grasp in response to stroking the palm), and palmomental (contraction of the facial muscle in response to stimulation of the thenar eminence near the thumb) reflexes in adults. These reflexes often signify progressive nervous system degeneration (Klein & Stewart-Amidei, 2012).

Gerontologic Considerations

During the normal aging process, the nervous system undergoes many changes and is more vulnerable to illness. Age-related changes in the nervous system vary in degree and must be distinguished from those due to disease. It is important for clinicians not to attribute abnormality or dysfunction to aging without appropriate investigation. For example, although diminished strength and agility are a normal part of aging, localized weakness can only be attributed to disease.

Structural and Physiologic Changes

As the brain ages, neurons are lost, leading to a decrease in the number of synapses and neurotransmitters. This results in slowed nerve conduction and response time. Brain weight is decreased, and the ventricle size increases to maintain cranial volume. Cerebral blood flow and metabolism are reduced, leading to slower mental functions. Temperature regulation becomes less efficient. In the peripheral nervous system, myelin is lost, resulting in a decrease in conduction velocity in some nerves. Visual and auditory nerves degenerate, leading to loss of visual acuity and hearing. Taste buds atrophy, and nerve cell fibers in the olfactory bulb degenerate (Jarvis, 2015). Nerve cells in the vestibular system of the inner ear, cerebellum, and proprioceptive pathways also degenerate, leading to balance difficulties. Deep tendon reflexes can be decreased or in some cases absent. Hypothalamic function is modified such that stage IV sleep is reduced. There is an overall slowing of autonomic nervous system responses. Pupillary responses are reduced or may not appear at all in the presence of cataracts.

Motor Alterations

Reduced nerve input into muscle contributes to an overall reduction in muscle bulk, with atrophy most easily noted in the hands. Changes in motor function often result in decreased strength and agility, with increased reaction time. Gait is often slowed and wide based. These changes can create difficulties in maintaining balance, predisposing the older person to falls.

Sensory Alterations

Tactile sensation is dulled in the older adult due to a decrease in the number of sensory receptors. There may be difficulty in identifying objects by touch, because fewer tactile cues are received from the bottom of the feet and the person may become confused about body position and location (Bates & Wolbers, 2014).

Sensitivity to glare, decreased peripheral vision, and a constricted visual field occur due to degeneration of visual pathways, resulting in disorientation, especially at night when there is little or no light in the room. Because the older adult takes longer to recover visual sensitivity when moving from a light to dark area, nightlights and a safe and familiar arrangement of furniture are essential.

Loss of hearing can contribute to confusion, anxiety, disorientation, misinterpretation of the environment, feelings of inadequacy, and social isolation. A decreased sense of taste and smell may contribute to weight loss and disinterest in food. A decreased sense of smell may present a safety hazard, because older adults living alone may be unable to detect household gas leaks or fires. Smoke and carbon monoxide detectors—important in every residence—are critical for the older adult.

Temperature Regulation and Pain Perception

The older adult patient may feel cold more readily than heat and may require extra covering when in bed; a room temperature somewhat higher than usual may be desirable. Reaction to painful stimuli may be decreased with age. Because pain is an important warning signal, caution must be used when hot or cold packs are used. The older patient may be burned or suffer frostbite before being aware of any discomfort. Complaints of pain such as abdominal discomfort or chest pain may be more serious than the patient's perception might indicate and thus require careful evaluation. In older adults, two common pain syndromes that affect the neurologic system are diabetic and postherpetic neuropathies. These frequently occur due to the high rate of these comorbid conditions in older adults. See Chapter 31 for a discussion of diabetic neuropathy.

Mental Status

Although mental processing time decreases with age, memory, language, and judgment capacities remain intact. Change in mental status should never be assumed to be a normal part of aging. Delirium is an acute confused state that begins with disorientation and if not recognized and treated early can progress to changes in level of consciousness, irreversible brain damage, and sometimes death. Older age is a risk, but delirium is also seen in patients who have underlying CNS damage or are experiencing an acute condition such as infection, adverse medication reaction, or dehydration. Drug toxicity and depression may produce impairment of attention and memory and should be evaluated as a possible cause of mental status change. The Confusion Assessment Method (CAM) is a commonly used screening tool (Inouye, van Dyck, Alessi, et al., 1990); (Layne, Haas, Davidson, et al., 2015) (see Chapter 62, Chart 62-7). Delirium must be differentiated from dementia, which is a chronic and irreversible deterioration of cognitive status. See Chapter 62, Table 62-3 for further discussion of delirium and dementia.

Nursing Implications

Nursing care for patients with age-related changes to the nervous system and for patients with long-term neurologic disability who are aging should include the modifications described previously. In addition, the consequences of any neurologic deficit and its impact on overall function such as activities of daily living, the use of assistive devices, and individual coping should be assessed and considered in planning patient care. Fall risk must be evaluated and fall prevention measures instituted for the patient who is hospitalized as well as in the home.

The nurse must understand the altered responses and the changing needs of the older adult patient before providing education. Visual and hearing deficits require adaptations in activities such as preoperative education, diet therapy, and education about new medications. When using visual materials for education or menu selection, adequate lighting without glare, contrasting colors, and large print are used to offset visual difficulties caused by rigidity and opacity of the lens in the eye and slower pupillary reaction. Procedures and preparations needed for diagnostic tests are explained, taking into account the possibility of impaired hearing and slowed responses in the older adult. Even with hearing loss, the older adult patient often hears adequately if the speaker uses a low-pitched, clear voice; shouting only makes it harder for the patient to understand the speaker. Providing auditory and visual cues aids understanding; if the patient has a significant hearing or visual loss, assistive devices, a signer, an interpreter, or a translator may be needed.

Providing instruction at an unrushed pace and using reinforcement enhance learning and retention. Material should be short, concise, and concrete. Vocabulary is matched to the patient's ability, and terms are clearly defined. The older adult patient requires adequate time to receive and respond to stimuli, learn, and react. These measures allow comprehension, memory, and formation of association and concepts.

Diagnostic Evaluation

A wide range of diagnostic studies may be performed in patients with altered neurologic function. The nurse should educate the patient about the purpose, what to expect, and any possible side effects related to these examinations prior to testing. Women who are premenopausal are advised to practice effective contraception before and for several days after any diagnostic procedure using contrast, and the woman who is breast-feeding is instructed to stop for the time period recommended by the nuclear medicine department (Pagana & Pagana, 2013). The nurse should note trends in results, because they provide information about disease progression as well as the patient's response to therapy.

Computed Tomography Scanning

Computed tomography (CT) scanning uses a narrow x-ray beam to scan body parts in successive layers. The images provide cross-sectional views of the brain, distinguishing differences in tissue densities of the skull, cortex, subcortical structures, and ventricles. An intravenous (IV) contrast agent may be used to highlight differences further. The brightness of each slice of the brain in the final image is proportional to the degree to which it absorbs x-rays. The image is displayed on an oscilloscope or television monitor and is photographed and stored digitally (Fischbach & Dunning, 2015). CT scanning is usually performed first without contrast material and then with IV contrast, if needed. The patient lies on an adjustable table with the head in a headrest while the scanning system rotates around the head and produces cross-sectional images. The patient must lie with the head held perfectly still without talking or moving the face, because head motion distorts the image. CT scanning is quick and painless and uses a small amount of radiation to produce images; it has a high degree of sensitivity for detecting lesions.

Brain lesions have a different tissue density from the surrounding normal brain tissue. Abnormalities detected on brain CT include tumor or other masses, infarction, hemorrhage, displacement of the ventricles, and cortical atrophy (Fischbach & Dunning, 2015). CT angiography allows visualization of blood vessels; in some situations, this eliminates the need for formal angiography. Whole-body CT scanners allow cross-sections of the spinal cord to be visualized. The injection of a water-soluble iodinated contrast agent into the subarachnoid space through lumbar puncture improves the visualization of the spinal and intracranial contents on these images. The CT scan, along with magnetic resonance imaging (MRI), has largely replaced myelography as a diagnostic procedure for the diagnosis of herniated lumbar discs.

Nursing Interventions

Essential nursing interventions include preparation for the procedure and patient monitoring. Preparation includes educating the patient about the need to lie quietly throughout the procedure. A review of relaxation techniques may be helpful for patients with claustrophobia. Sedation can be used if agitation, restlessness, or confusion interferes with a successful study. Ongoing patient monitoring during sedation is necessary. If a contrast agent is used, the patient must be assessed before the CT scan for an iodine/shellfish allergy, because the contrast agent used may be iodine based. Kidney function must also be evaluated because the contrast material is cleared through the kidneys. A suitable IV line for contrast injection and a period of fasting (usually 4 hours) are required prior to the study. Patients who receive an IV contrast agent are monitored during and after the procedure for allergic reactions and changes in kidney function (Fischbach & Dunning, 2015). Fluid intake is also encouraged after IV contrast to facilitate contrast clearance through the kidney.

Magnetic Resonance Imaging

MRI uses a powerful magnetic field to obtain images of different areas of the body. The magnetic field causes the hydrogen nuclei (protons) within the body to align like small magnets in a magnetic field. In combination with radiofrequency pulses, the protons emit signals, which are converted to images. An MRI scan can be performed with or without a contrast agent and can identify a cerebral abnormality earlier and more clearly than other diagnostic tests (Fischbach & Dunning, 2015). It can provide information about the chemical changes within cells, allowing the clinician to monitor a tumor's response to treatment. It is particularly useful in the diagnosis of brain tumor, stroke, and multiple sclerosis and does not involve ionizing radiation. An MRI scan may take an hour or longer to complete, so its use in emergency situations is limited.

Several MRI applications allow imaging of brain blood flow and metabolism via special imaging techniques added to the MRI. Such techniques include diffusion-weighted imaging (DWI), perfusion-weighted imaging (PWI), magnetic resonance spectroscopy, and fluid attenuation inversion recovery (FLAIR) (Fischbach & Dunning, 2015). Magnetic resonance angiography (MRA) allows separate visualization of the cerebral vasculature without the administration of an arterial contrast agent. Both MRI and CT images are used as tools to plan and direct surgical intervention.

Nursing Interventions

Patient preparation includes providing education and obtaining an adequate history. Ferromagnetic substances in the body may become dislodged by the magnet, so history of working with metal fragments must be reviewed. The patient is questioned about any implants of any metal objects (e.g., aneurysm clips, orthopedic hardware, pacemakers, artificial heart valves, intrauterine devices). These objects could malfunction, be dislodged, or heat up as they absorb energy. Cochlear implants will be inactivated by MRI; therefore, other imaging procedures are considered. A complete list of metal compatibility may be found on MRI manufacturer Web sites.

Before the patient enters the room where the MRI is to be performed, all metal objects and credit cards (the magnetic field can erase them) must be removed. This includes medication patches that have a metal backing and metallic lead wires; these can cause burns if not removed (Fischbach & Dunning, 2015). No metal objects may be brought into the room where the MRI is located; this includes oxygen tanks, IV poles, ventilators, or even stethoscopes. The magnetic field generated by the unit is so strong that any metal-containing items will be strongly attracted and literally can be pulled away with such force that they fly like projectiles toward the magnet. There is a risk of severe injury and death. Further, damage to expensive equipment may occur.

Nursing Alert: For patient safety, the nurse prevents any patient care equipment containing metal or metal parts (e.g., portable oxygen tanks) from entering the room where the MRI is located. The nurse also assesses the patient for the presence of medication patches with foil backing (such as nicotine patches) that may cause a burn while an MRI scan is being performed.

For the MRI, the patient lies with the head in a frame on a flat platform that is moved into a tube housing the magnet (see Fig. 48-14). The tube is narrow; persons with a wide girth may not fit into the scanner. Patients who are unable to lie flat will not be able to tolerate an MRI. The scanning process is painless, but the patient hears loud thumping of the magnetic coils as the magnetic field is being pulsed. Patients may experience claustrophobia while inside the narrow tube; sedation may be prescribed in these circumstances. "Open" MRI machines are less claustrophobic than the other devices and are available in many locations. However, the images produced on these machines are sometimes not so detailed, and traditional devices are preferred for accurate diagnosis. The patient may be educated about the use of relaxation techniques while in the scanner. The patient is informed that he or she will be able to talk to the staff during the scan through a microphone inside the scanner (Fischbach & Dunning, 2015).



Figure 48-14 • Technician explains what to expect during a magnetic resonance imaging procedure.

Positron Emission Tomography

PET is a computer-based nuclear imaging technique that produces images of actual organ functioning. The patient either inhales a radioactive gas or is injected with a radioactive substance that emits positively charged particles. When these positrons combine with negatively charged electrons (normally found in the body's cells), the resultant gamma rays can be detected by a scanning device that produces a series of two-dimensional views at various levels of the brain. This information is integrated by a computer and gives a composite picture of the brain at work.

PET permits the measurement of blood flow, tissue composition, and brain metabolism and thus indirectly evaluates brain function. The brain is one of the most metabolically active organs, consuming 80% of the glucose the body uses (Bader et al., 2016). PET measures this activity in specific areas of the brain and can detect changes in glucose use.

PET is useful in showing metabolic changes in the brain (Alzheimer disease), locating lesions (brain tumor, epileptogenic lesions), identifying blood flow and oxygen metabolism in patients with strokes, distinguishing tumor from areas of necrosis, and revealing biochemical abnormalities associated with mental illness. The isotopes used have a very short half-life and are expensive to produce, requiring specialized equipment for production. Improvement in the scanning procedure and production of isotopes, as well as the advent of reimbursement by third-party payers, has increased the clinical applications of PET studies.

Nursing Interventions

Key nursing interventions include patient preparation, which involves explaining the test and educating the patient about inhalation techniques and the sensations (e.g., dizziness, lightheadedness, and headache) that may occur. The IV injection of the radioactive substance produces similar side effects. Relaxation exercises may reduce anxiety during the test.

Single-Photon Emission Computed Tomography

SPECT is a three-dimensional imaging technique that uses radionuclides and instruments to detect single photons. It is a perfusion study that captures a moment of cerebral blood flow at the time of injection of a radionuclide. Gamma photons are emitted from a radiopharmaceutical agent given to the patient and are detected by a rotating gamma camera or cameras; the image is sent to a minicomputer. This approach allows areas behind overlying structures or background to be viewed, greatly increasing the contrast between normal and abnormal tissue. It is relatively inexpensive, and the duration is similar to that of a CT scan.

SPECT is useful in detecting the extent and location of abnormally perfused areas of the brain, thus allowing detection, localization, and sizing of stroke (before it is visible by CT scan); localization of seizure foci in epilepsy; detection of tumor progression (Fischbach & Dunning, 2015); and evaluation of perfusion before and after neurosurgical procedures.

Nursing Interventions

The nursing interventions for SPECT primarily include patient preparation and patient monitoring. Providing education about what to expect before the test can allay anxiety and ensure patient cooperation during the test. Pregnancy and breast-feeding are contraindications to SPECT.

The nurse may need to accompany and monitor the patient during transport to the nuclear medicine department for the scan. Patients are monitored during and after the procedure for allergic reactions to the radiopharmaceutical agent.

Cerebral Angiography

Cerebral angiography is an x-ray study of the cerebral circulation with a contrast agent injected into a selected artery. A valuable tool in investigating vascular disease or anomalies, it is used to determine vessel patency, identify presence of collateral circulation, and provide detail on vascular anomalies that can be used in planning interventions. With the advent of additional imaging techniques, formal cerebral angiography is less frequently performed.

Cerebral angiograms are performed by threading a catheter through the femoral artery in the groin and up to the desired vessel. Alternatively, direct puncture of the carotid artery may be performed. X-ray images are obtained as the contrast agent flows through the vessels; the carotid and vertebral arterial systems are visualized, as well as venous drainage. Arterial access may also be used for interventional procedures, such as placing coils in an aneurysm or arteriovenous malformation.

Nursing Interventions

Prior to the angiography, the patient's blood urea nitrogen and creatinine should be checked to ensure the kidneys will be able to excrete the contrast agent. The patient should be well hydrated, and clear liquids are usually permitted up to the time of the test. The patient is instructed to void immediately before the test, and locations of the appropriate peripheral pulses are marked with a felt-tip pen. The patient is instructed to remain immobile during the angiogram process and is told to expect a brief feeling of warmth in the face, behind the eyes, or in the jaw, teeth, tongue, and lips, and a metallic taste when the contrast agent is injected.

After the hair in the groin is clipped and prepared, a local anesthetic agent is given to minimize pain at the insertion site and to reduce arterial spasm. A catheter is introduced into the femoral artery, flushed with heparinized saline, and filled with contrast agent. Fluoroscopy is used to guide the catheter to the appropriate vessels. Neurologic assessment is conducted during and immediately following cerebral angiography to observe for embolism or arterial dissection that may occur during the test. Signs of these complications include new onset of alterations in the level of consciousness, weakness on one side of the body, motor or sensory deficits, and speech disturbances.

Nursing care after cerebral angiography includes observation of the injection site for bleeding or hematoma formation (a localized collection of blood). Because a hematoma at the puncture site or embolization to a distal artery affects peripheral pulses, the peripheral pulses that were marked prior to the test are monitored frequently. The color and temperature of the involved extremity are assessed to detect possible embolism (Fischbach & Dunning, 2015). Fluids are encouraged to facilitate clearance of the contrast through the kidney. The nurse also monitors for an allergic reaction to the contrast agent.

Myelography

A myelogram is an x-ray of the spinal subarachnoid space taken after the injection of a contrast agent into the spinal subarachnoid space through a lumbar puncture. The water-based contrast agent disperses upward through the CSF to outline the spinal subarachnoid space and shows any distortion of the spinal cord or spinal dural sac caused by tumors, cysts, herniated vertebral discs, or other lesions. Myelography is performed infrequently today because of the sensitivity of CT and MRI scanning (Fischbach & Dunning, 2015).

Nursing Interventions

The patient is educated about what to expect during the procedure and made aware that changes in position may be made during the procedure. After myelography, the patient lies in bed with the head of the bed elevated 30 to 45 degrees. The patient is advised to remain in bed in the recommended position for 3 hours or as prescribed. Drinking liberal amounts of fluid for rehydration and replacement of CSF may decrease the incidence of post–lumbar puncture headache. The blood pressure, pulse, respiratory rate, and temperature are monitored, as well as the patient's ability to void. Untoward signs include headache, fever, stiff neck, photophobia (sensitivity to light), seizures, and signs of chemical or bacterial meningitis (Hickey, 2014).

Noninvasive Carotid Flow Studies

Noninvasive carotid flow studies use ultrasound imagery and Doppler measurements of arterial blood flow to evaluate carotid and deep orbital circulation. The graph produced indicates blood velocity. Increased blood velocity can indicate stenosis or partial

obstruction. These tests are often obtained before more invasive tests such as arteriography or are used as screening tools. Carotid Doppler, carotid ultrasonography, oculoplethysmography, and ophthalmodynamometry are four common noninvasive vascular techniques that permit evaluation of arterial blood flow and detection of arterial stenosis, occlusion, and plaques. These vascular studies allow noninvasive imaging of extra- and intracranial circulation (Fischbach & Dunning, 2015).

Transcranial Doppler

Transcranial Doppler uses the same noninvasive techniques as carotid flow studies but records the blood flow velocities of the intracranial vessels. Arterial flow velocities can be measured through thin areas of the temporal and occipital bones of the skull. A handheld Doppler probe emits a pulsed beam; the signal is reflected by the moving red blood cells within the blood vessels. Transcranial Doppler is a noninvasive technique that is helpful in assessing vasospasm (a complication following subarachnoid hemorrhage), altered cerebral blood flow found in occlusive vascular disease, other cerebral pathology, and brain death.

Nursing Interventions

When a carotid flow study or transcranial Doppler is scheduled, the procedure is described to the patient. The patient is informed that this is a noninvasive test, that a handheld transducer will be placed over the neck and the orbits of the eyes, and that a water-soluble gel or lubricant is used on the transducer (Fischbach & Dunning, 2015). Either of these two low-risk tests can be performed at the patient's bedside.

Electroencephalography

An electroencephalogram (EEG) represents a record of the electrical activity generated in the brain (Hickey, 2014). It is obtained through electrodes applied on the scalp or through microelectrodes placed within the brain tissue. It provides an assessment of cerebral electrical activity. It is useful for diagnosing and evaluating seizure disorders, coma, or organic brain syndrome. Tumors, brain abscesses, blood clots, and infection may cause abnormal patterns in electrical activity. The EEG is also used in making a determination of brain death.

Electrodes are applied to the scalp to record the electrical activity in various regions of the brain. The amplified activity of the neurons between any two of these electrodes is recorded on continuously moving paper; this record is called the *encephalogram*.

For a baseline recording, the patient lies quietly with both eyes closed. The patient may be asked to hyperventilate for 3 to 4 minutes or to look at a bright, flashing light for photic stimulation. These activation procedures are performed to evoke abnormal electrical discharges, such as seizure potentials. A sleep EEG may be recorded after sedation because some abnormal brain waves are seen only when the patient is asleep. If the epileptogenic area is inaccessible to conventional scalp electrodes, nasopharyngeal electrodes may be used.

Depth recording of EEG is performed by introducing electrodes stereotactically (radiologically placed using instrumentation) into a target area of the brain, as indicated by the patient's seizure pattern and scalp EEG. It is used to identify patients who may benefit from surgical excision of epileptogenic foci. Special transsphenoidal, mandibular, and nasopharyngeal electrodes can be used, and video recording combined with EEG monitoring and telemetry is used in hospital settings to capture epileptiform abnormalities and their sequelae. Some epilepsy centers provide long-term ambulatory EEG monitoring with portable recording devices (Bader et al., 2016).

Nursing Interventions

To increase the chances of recording seizure activity, it is sometimes recommended that the patient be deprived of sleep the night before the EEG. Anticonvulsant agents, tranquilizers, stimulants, and depressants should be withheld 24 to 48 hours before an EEG, because these medications can alter the EEG wave patterns or mask the abnormal wave patterns of seizure disorders (Pagana & Pagana, 2013). Coffee, tea, chocolate, and cola drinks are omitted from the meal before the test because of their stimulating effect. However, the meal itself is not omitted, because an altered blood glucose level can cause changes in brain wave patterns.

The patient is informed that the standard EEG takes 45 to 60 minutes; a sleep EEG requires 12 hours. The patient is assured that the procedure does not cause an electric shock and that the EEG is a diagnostic test, not a form of treatment. An EEG requires the patient to lie quietly during the test. Sedation is not advisable, because it may lower the seizure threshold in patients with a seizure disorder and it alters brain wave activity in all patients. The nurse needs to check the prescription regarding the administration of anticonvulsant medication prior to testing.

Routine EEGs use a water-soluble lubricant for electrode contact, which can be wiped off and removed by shampooing later. Sleep EEGs involve the use of collodion glue for electrode contact, which requires acetone for removal.

Electromyography

An electromyogram (EMG) is obtained by inserting needle electrodes into the skeletal muscles to measure changes in the electrical potential of the muscles (Pagana & Pagana, 2013). The electrical potentials are shown on an oscilloscope and amplified so that both the sound and appearance of the waves can be analyzed and compared simultaneously.

An EMG is useful in determining the presence of neuromuscular disorders and myopathies. It helps distinguish weakness due to neuropathy (functional or pathologic changes in the peripheral nervous system) from weakness resulting from other causes.

Nursing Interventions

The procedure is explained, and the patient is warned to expect a sensation similar to that of an intramuscular injection as the needle is inserted into the muscle. The muscles examined may ache for a short time after the procedure.

Nerve Conduction Studies

Nerve conduction studies are performed by stimulating a peripheral nerve at several points along its course and recording the muscle action potential or the sensory action potential that results. Surface or needle electrodes are placed on the skin over the nerve to stimulate the nerve fibers. This test is useful in the study of peripheral neuropathies and is often included as part of the EMG.

Evoked Potential Studies

Evoked potential studies involve application of an external stimulus to specific peripheral sensory receptors with subsequent measurement of the electrical potential generated. Electrical changes are detected with the aid of computerized devices that extract the signal, display it on an oscilloscope, and store the data on magnetic tape or disc. In neurologic diagnosis, they reflect nerve conduction times in the peripheral nervous system. In clinical practice, the visual, auditory, and somatosensory systems are most often tested.

In visual evoked responses, the patient looks at a visual stimulus (flashing lights, a checkerboard pattern on a screen). The average of several hundred stimuli is recorded by EEG leads placed over the occipital lobe. The transit time from the retina to the occipital area is measured using computer-averaging methods.

Brainstem auditory evoked responses (BAERs) are measured by applying an auditory stimulus (repetitive auditory click) and measuring the transit time via the brain stem into the cortex. Specific lesions in the auditory pathway modify or delay the response. BAERs may be used in the diagnosis of brain stem abnormalities and in determination of brain death.

In somatosensory evoked responses (SERs), the peripheral nerves are stimulated (electrical stimulation through skin electrodes) and the transit time along the spinal cord to the cortex is measured and recorded from scalp electrodes. SERs are used to detect deficits in spinal cord or peripheral nerve conduction and to monitor spinal cord function during surgical procedures. It is also useful in the diagnosis of demyelinating diseases, such as multiple sclerosis and polyneuropathies, where nerve conduction is slowed.

Nursing Interventions

The nurse explains the procedure and reassures the patient and encourages him or her to relax. The patient is advised to remain perfectly still throughout the recording to prevent artifacts (signals not generated by the brain) that interfere with the recording and interpretation of the test.

Lumbar Puncture and Examination of Cerebrospinal Fluid

A lumbar puncture (spinal tap) is carried out by inserting a needle into the lumbar subarachnoid space to withdraw CSF. The test may be performed to obtain CSF for examination, to measure and reduce CSF pressure, to determine the presence or absence of blood in the CSF, and to administer medications intrathecally (into the spinal canal).

The needle is usually inserted into the subarachnoid space between the third and fourth or fourth and fifth lumbar vertebrae. Because the spinal cord ends at the first lumbar vertebra, insertion of the needle below the level of the third lumbar vertebra prevents puncture of the spinal cord.

A successful lumbar puncture requires that the patient be relaxed; a patient who is anxious is tense, and this may increase the pressure reading. CSF pressure with the patient in a lateral recumbent position is normally 80 to 100 mm H_2O or 8 to 14 mm Hg (Hickey, 2014).

A lumbar puncture may be risky in the presence of an intracranial mass lesion because intraspinal pressure is decreased by removal of CSF, and the brain may herniate downward through the foramen magnum. Chart 48-4 provides instructions for assisting with a lumbar puncture.

Cerebrospinal Fluid Analysis

The CSF should be clear and colorless. Pink, blood-tinged, or grossly bloody CSF may indicate a subarachnoid hemorrhage. The CSF may be bloody initially because of local trauma but becomes clearer as more fluid is drained. Specimens are obtained for cell count, culture, glucose, protein, and other tests as indicated. The specimens should be sent to the laboratory immediately because changes will take place and alter the result if the specimens are allowed to stand. See Table A-5 in Appendix A on for the normal values of CSF.

Post–Lumbar Puncture Headache

A post–lumbar puncture headache, ranging from mild to severe, may occur a few hours to several days after the procedure. It is a throbbing bifrontal or occipital headache that is dull and deep in character. It is particularly severe on sitting or standing but lessens or disappears when the patient lies down.

The headache is caused by CSF leakage at the puncture site. The fluid continues to escape into the tissues by way of the needle track from the spinal canal. As a result of a leak, the supply of CSF in the cranium is depleted to a point at which it is insufficient to maintain proper mechanical stabilization of the brain. When the patient assumes an upright position, tension and stretching of the venous sinuses and pain-sensitive structures occur.

Post–lumbar puncture headache may be avoided if a small-gauge needle is used and if the patient remains prone after the procedure. The patient is positioned supine for 4 to 8 hours (Hickey, 2014). A postpuncture headache is usually managed by bed rest, analgesic agents, and hydration.

Other Complications of Lumbar Puncture

Herniation of the intracranial contents, spinal epidural abscess, spinal epidural hematoma, and meningitis are rare but serious complications of lumbar puncture. Other complications include temporary voiding problems, slight elevation of temperature, backache or spasms, and stiffness of the neck.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

Many diagnostic tests that were once performed as part of a hospital stay are now carried out in short-procedure units or outpatient testing settings or units. As a result, family members often provide the postprocedure care. Therefore, the patient and family must receive adequate education about precautions to take after the procedure, complications to watch for, and steps to take if complications occur. Because many patients undergoing neurologic diagnostic studies are older adults or have neurologic deficits, provisions must be made to ensure that transportation, postprocedure care, and appropriate monitoring are available.

Continuing and Transitional Care

Contacting the patient and family after diagnostic testing enables the nurse to determine whether they have any questions about the procedure or whether the patient had any untoward results. Education is reinforced and the patient and family are reminded to make and keep follow-up appointments. Patients, family members, and health care providers are focused on the immediate needs, issues, or deficits that necessitated the diagnostic testing.

Chart 48-4

Assisting with a Lumbar Puncture

A needle is inserted into the subarachnoid space through the third and fourth or fourth and fifth lumbar interface to withdraw spinal fluid.

Preprocedure

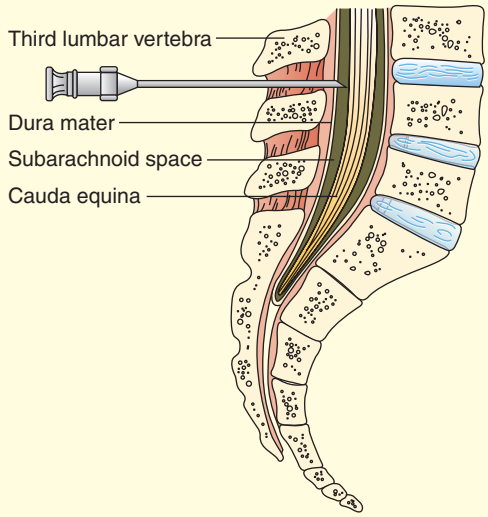
1. Determine whether written consent for the procedure has been obtained.
2. Explain the procedure to the patient, and describe sensations that are likely during the procedure (i.e., a sensation of cold as the site is cleansed with solution, a needle prick when local anesthetic agent is injected).
3. Determine whether the patient has any questions or misconceptions about the procedure; reassure the patient that the needle will not enter the spinal cord or cause paralysis.
4. Instruct the patient to void before the procedure.

Procedure

1. The patient is positioned on one side at the edge of the bed or examining table with the back toward the physician; the thighs and legs are flexed as much as possible to increase the space between the spinous processes of the vertebrae, for easier entry into the subarachnoid space.



2. A small pillow may be placed under the patient's head to maintain the spine in a horizontal position; a pillow may be placed between the legs to prevent the upper leg from rolling forward.
3. The nurse assists the patient to maintain the position to avoid sudden movement, which can produce a traumatic (bloody) tap.
4. The patient is encouraged to relax and is instructed to breathe normally, because hyperventilation may lower an elevated pressure.
5. The nurse describes the procedure step by step to the patient as it proceeds.
6. The physician cleanses the puncture site with an antiseptic agent solution and drapes the site.
7. The physician injects local anesthetic agent to numb the puncture site and then inserts a spinal needle into the subarachnoid space through the third and fourth or fourth and fifth lumbar interspace. A pressure reading may be obtained.
8. A specimen of cerebrospinal fluid (CSF) is removed and usually collected in three test tubes, labeled in order of collection. The needle is withdrawn.
9. The physician applies a small dressing to the puncture site.
10. The tubes of CSF are sent to the laboratory immediately.



Postprocedure

1. Instruct the patient to lie prone to separate the alignment of the dural and arachnoid needle punctures in the meninges, to reduce leakage of CSF.
2. Monitor the patient for complications of lumbar puncture; notify primary provider if complications occur.
3. Encourage increased fluid intake to reduce the risk of postprocedure headache.

CRITICAL THINKING EXERCISES

1. Identify the priorities, approach, and techniques you would use to perform a neurologic assessment on a 82-year-old patient with confusion. How will your priorities, approach, and techniques differ if the patient has a visual impairment, is hard of hearing, or has lower extremity weakness?
2. A 40-year-old patient is scheduled for an electroencephalogram (EEG). What resources would you use to identify the current guidelines for EEG? What is the evidence base for these practices? Identify the criteria used to evaluate the strength of the evidence for these practices.
3. A 35-year-old female patient is having a lumbar puncture at the bedside. Identify the nursing interventions indicated before, during, and after the procedure. What patient education is indicated? How will your nursing interventions and patient education change if the patient is pregnant or lactating?

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference

Books

Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Fischbach, F. T., & Dunning, M. B. (2015). Nurse's quick reference to common laboratory and diagnostic tests (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

**Herndon, R. M. (2006). Handbook of neurologic rating scales (2nd ed.). New York: Demos Medical Publishing.

Hickey, J. (2014). Clinical practice of neurological and neurosurgical nursing (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Hickey, J. V. (2014). The clinical practice of neurological and neurosurgical nursing (7th ed.). Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Jarvis, C. (2015). Physical examination and health assessment (7th ed.). Philadelphia, PA: Saunders.

Klein, D. G., & Stewart-Amidei, C. (2012). Nervous system alterations. In M. L. Sole, D. G. Klein, & M. J. Moseley (Eds.). Introduction to critical care nursing (6th ed.). St. Louis, MO: Elsevier Saunders.

Pagana, K. D., & Pagana, T. J. (2013). Manual of diagnostic and laboratory tests (5th ed.). St. Louis, MO: Mosby Elsevier.

Porth, C. M. (2014). Essentials of pathophysiology (4th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

**Posner, J. B., Saper, C. B., Schiff, N. D., et al. (2007). Plum and Posner's diagnosis of stupor and coma (4th ed.). Oxford, UK: Oxford University Press.

Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

*Arbour, C., Gelinas, C., Loiselle, C. G., et al. (2015). An exploratory study of the Bilateral Bispectral Index for pain detection in traumatic brain injured patients with altered level of consciousness. Journal of Neuroscience Nursing, 47(3), 166–177.

Bates, S. L., & Wolbers, T. (2014). How cognitive aging affects multisensory integration of navigational cues. Neurobiology of Aging, 35(12), 2761–2767.

**Inouye, S. K., van Dyck, C. H., Alessi, C. A., et al. (1990). Clarifying confusion: The confusion assessment method. Annals of Internal Medicine, 113(12), 941–948.

Layne, T., Haas, S. A., Davidson, J. E., et al. (2015). Postoperative delirium prevention in the older adult: An evidence-based process improvement project. MedSurg Nursing, 24(4), 256–263.

Poulsen, I., Brix, P., Andersen, S., et al. (2016). Pain assessment scale for patients with disorders of consciousness: A preliminary validation study. Journal of Neuroscience Nursing, 48(3), 124–131.

Resources

American Headache Society, www.americanheadachesociety.org

Brain Injury Association of America, www.biausa.org

Brain Trauma Foundation, www.braintrauma.org

Epilepsy Foundation, www.epilepsy.com

Harvard Health Publications, Harvard Medical School Office of Public Affairs, www.health.harvard.edu/diagnostic-tests/#brain

National Headache Foundation, www.headaches.org

CHAPTER 49

Management of Patients with Neurologic Dysfunction

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe the causes, clinical manifestations, and medical management of various neurologic dysfunctions.
2. Use the nursing process as a framework for care of the multiple needs of the patient with altered level of consciousness.
3. Identify the early and late clinical manifestations of increased intracranial pressure.
4. Apply the nursing process as a framework for care of the patient with increased intracranial pressure.
5. Compare and contrast the indications for intracranial or transsphenoidal surgery.
6. Use the nursing process as a framework for care of the patient undergoing intracranial or transsphenoidal surgery.
7. Explain the various types and causes of seizures and develop a plan of care for the patient experiencing seizures.
8. Recognize the causes, clinical manifestations, and medical and nursing management of the patient experiencing various types of headaches.

GLOSSARY

akinetic mutism: unresponsiveness to the environment; the patient makes no movement or sound but sometimes opens the eyes
altered level of consciousness (LOC): when a patient is not oriented, does not follow commands, or needs persistent stimuli to achieve a state of alertness
brain death: irreversible loss of all functions of the entire brain, including the brainstem
coma: prolonged state of unconsciousness
craniectomy: a surgical procedure that involves removal of a portion of the skull
craniotomy: a surgical procedure that involves entry into the cranial vault
Cushing's response: the brain's attempt to restore blood flow by increasing arterial pressure to overcome the increased intracranial pressure
decerebration: an abnormal body posture associated with a severe brain injury, characterized by extreme extension of the upper and lower extremities
decortication: an abnormal posture associated with severe brain injury, characterized by abnormal flexion of the upper extremities and extension of the lower extremities
epilepsy: at least two unprovoked seizures occurring more than 24 hours apart
herniation: abnormal protrusion of tissue through a defect or natural opening
intracranial pressure (ICP): pressure exerted by the volume of the intracranial contents within the cranial vault
locked-in syndrome: condition resulting from a lesion in the pons in which the patient lacks all distal motor activity (paralysis) but cognition is intact
migraine: a severe, unrelenting headache often accompanied by symptoms such as nausea, vomiting, and visual disturbances
minimally conscious state: a state in which the patient demonstrates awareness but cannot communicate thoughts or feelings
Monro–Kellie hypothesis: theory that states that due to limited space for expansion within the skull, an increase in any one of the cranial contents—brain tissue, blood, or cerebrospinal fluid (CSF)—causes a change in the volume of the others; also referred to as Monro–Kellie doctrine
persistent vegetative state: condition in which the patient is wakeful but devoid of conscious content, without cognitive or affective mental function
primary headache: a headache for which no specific organic cause can be found
secondary headache: headache identified as a symptom of another organic disorder (e.g., brain tumor, hypertension)
seizures: paroxysmal transient disturbance of the brain resulting from a discharge of abnormal electrical activity
status epilepticus: episode in which the patient experiences multiple seizures with no recovery time in between
transsphenoidal: surgical approach to the pituitary via the sphenoid sinuses

Introduction

This chapter presents an overview of care of the patient with an altered level of consciousness (LOC); the patient with increased intracranial pressure (ICP); and the patient who is undergoing neurosurgical procedures, experiencing seizures, or experiencing headaches. Some of the disorders in this chapter, such as headaches and seizures, may be symptoms of dysfunction in another body system. Alternatively, headaches and seizures can be symptoms of a disruption of the neurologic system. These disorders can also be diagnosed at times as "idiopathic," or without an identifiable cause. The commonalities of these disorders are often the behaviors and needs of the patient and the approaches nurses use to support the patient.

The central nervous system (CNS) contains a vast network of neurons that control the body's vital functions. However, this system is vulnerable, and its optimal function depends on several key factors. First, the neurologic system relies on its structural integrity for support and homeostasis, but this integrity may be disrupted. Examples of structural disruption include head injury, brain tumor, intracranial hemorrhage, infection, and stroke. As brain tissue expands in the inflexible cranium, intracranial pressure (ICP) (pressure exerted by the volume of the intracranial contents within the cranial vault)

rises, and cerebral perfusion is impaired. Further expansion places pressure on vital centers, which can cause permanent neurologic deficits or lead to brain death.

Second, the neurologic system relies on the body's ability to maintain a homeostatic environment. It requires the delivery of the essential elements of oxygen and glucose, as well as filtration of substrates that are toxic to the neurons. The functions of the neurologic system may be decreased or absent because of the effect of toxic substrates or the body's inability to provide essential substrates. Sepsis, hypovolemia, myocardial infarction, cardiopulmonary arrest, hypoglycemia, electrolyte imbalance, drug and/or alcohol overdose, encephalopathy, and ketoacidosis are examples of such circumstances. Some conditions can be treated and reversed; others result in permanent neurologic deficits and disabilities.

Although the specialty of neuroscience nursing requires an understanding of neuroanatomy, neurophysiology, neurodiagnostic testing, critical care nursing, and rehabilitation nursing, nurses in all settings care for patients with neurologic disorders (Hickey, 2014). Ongoing assessment of the patient's neurologic function and health needs, identification of problems, mutual goal setting, development and implementation of care plans (including education, counseling, and coordinating activities), and evaluation of the outcomes of care are nursing actions integral to the recovery of the patient. The nurse also collaborates with other members of the health care team to provide essential care, offer a variety of solutions to problems, help the patient and family gain control of their lives, and explore the educational and supportive resources available in the community. The goals are to achieve as high a level of function as possible and to enhance the quality of life for the patient with neurologic impairment and their family.

ALTERED LEVEL OF CONSCIOUSNESS

An altered level of consciousness (LOC) is present when the patient is not oriented, does not follow commands, or needs persistent stimuli to achieve a state of alertness. LOC is gauged on a continuum, with a normal state of alertness and full cognition (consciousness) on one end and coma on the other end. Coma is a clinical state of unarousable unresponsiveness in which there are no purposeful responses to internal or external stimuli, although nonpurposeful responses to painful stimuli and brainstem reflexes may be present. The usual duration of coma is variable. Akinetic mutism is a state of unresponsiveness to the environment in which the patient makes no voluntary movement. Persistent vegetative state is a condition in which the unresponsive patient resumes sleep–wake cycles after coma but is devoid of cognitive or affective mental function. A minimally conscious state differs from persistent vegetative state in that the patient has inconsistent but reproducible signs of awareness (Bruno, Laureys, & Demertzi, 2013). Locked-in syndrome results from a lesion affecting the pons and results in paralysis and the inability to speak, but vertical eye movements and lid elevation remain intact and are used to indicate responsiveness (Bruno et al., 2013). The level of responsiveness and consciousness is the most important indicator of the patient's condition.

Pathophysiology

Altered LOC is not a disorder itself; rather, it is a result of multiple pathophysiologic phenomena. The cause may be neurologic (head injury, stroke), toxicologic (drug overdose, alcohol intoxication), or metabolic (hepatic or kidney injury, diabetic ketoacidosis).

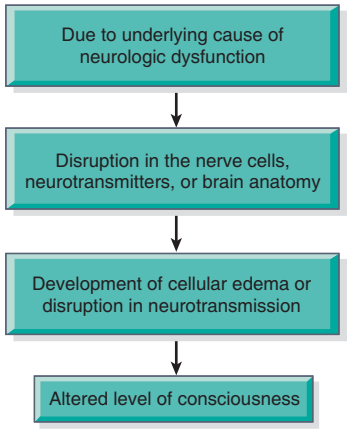


Figure 49-1 • Pathophysiology of altered level of consciousness.

The underlying cause of neurologic dysfunction is disruption in the cells of the nervous system, neurotransmitters, or brain anatomy (see Chapter 48). Disruptions result from cellular edema or other mechanisms, such as disruption of chemical transmission at receptor sites by antibodies.

Intact anatomic structures of the brain are needed for normal function. The two hemispheres of the cerebrum must communicate, via an intact corpus callosum, and the lobes of the brain (frontal, parietal, temporal, and occipital) must communicate and coordinate their specific functions (see Chapter 48). Other anatomic structures of importance are the cerebellum and the brainstem. The cerebellum has both excitatory and inhibitory actions and is largely responsible for coordination of movement. The brainstem contains areas that control the heart rate, respiration, and blood pressure. Disruptions in the anatomic structures result from trauma, edema, pressure from tumors, or other mechanisms, such as an increase or decrease in the circulation of blood or CSF. A flowchart for pathophysiology of altered level of consciousness is presented in Figure 49-1.

Clinical Manifestations

Alterations in LOC occur along a continuum, and the clinical manifestations depend on where the patient is on this continuum. As the patient's state of alertness and consciousness decreases, changes occur in the pupillary response, eye opening response, verbal response, and motor response. However, initial alterations in LOC may be reflected by subtle behavioral changes, such as restlessness or increased anxiety. The pupils, normally round and quickly reactive to light, become sluggish (response is slower); as the patient becomes comatose, the pupils become fixed (no response to light). The patient in a coma does not open the eyes to voice or command, respond verbally, or move the extremities in response to a request to do so.

Assessment and Diagnostic Findings

The patient with an altered LOC is at risk for alterations in every body system. A complete assessment is performed, with particular attention to the neurologic system. The neurologic examination should be as complete as the LOC allows. It

includes an evaluation of mental status, cranial nerve function, cerebellar function (balance and coordination), reflexes, and motor and sensory function. LOC, a sensitive indicator of neurologic function, is assessed based on the criteria in the Glasgow Coma Scale: eye opening, verbal response, and motor response (Hickey, 2014). The patient's responses are rated on a scale from 3 to 15. A score of 3 indicates severe impairment of neurologic function, brain death, or pharmacologic inhibition of the neurologic response. A score of 15 indicates that the patient is fully responsive (see Chapter 51).

If the patient is comatose and has localized signs such as abnormal pupillary and motor responses, it is assumed that neurologic disease is present until proven otherwise. If the patient is comatose but pupillary light reflexes are preserved, a toxic or metabolic disorder is suspected. Common diagnostic procedures used to identify the cause of unconsciousness include computed tomography (CT) scanning, perfusion CT (PCT), magnetic resonance imaging (MRI), magnetic resonance spectroscopy (MRS), and electroencephalography (EEG). Additional procedures include positron emission tomography (PET) and single-photon emission computed tomography (SPECT) (see Chapter 48). Emerging research identifies EEG, MRI, and PET as important technologies in determining brain function through the evaluation of metabolic and electrical activity (Van Der Naalt, 2015). Laboratory tests include analysis of blood glucose, electrolytes, serum ammonia, and liver function tests; blood urea nitrogen (BUN) levels; serum osmolality; calcium level; and partial thromboplastin and prothrombin times. Other studies may be used to evaluate serum ketones, alcohol and drug concentrations, and arterial blood gases.

Medical Management

The first priority of treatment for the patient with altered LOC is to obtain and maintain a patent airway. The patient may be orally or nasally intubated, or a tracheostomy may be performed. Until the ability of the patient to breathe is determined, a mechanical ventilator is used to maintain adequate oxygenation and ventilation. The circulatory status (blood pressure, heart rate) is monitored to ensure adequate perfusion to the body and brain. An intravenous (IV) catheter is inserted to provide access for IV fluids and medications. Neurologic care focuses on the specific neurologic pathology, if known. Nutritional support, via a feeding tube or a gastrostomy tube, is initiated as soon as possible. In addition to measures designed to determine and treat the underlying causes of altered LOC, other medical interventions are aimed at pharmacologic management and prevention of complications.

NURSING PROCESS

The Patient with an Altered Level of Consciousness

Assessment

Assessment of the patient with an altered LOC often starts with assessing the verbal response through determining the patient's orientation to time, person, and place. Patients are asked to identify the day, date, or season of the year, as well as where they are or the clinicians, family members, or visitors present. Other questions such as "Who is the Prime Minister?" or "What is the next holiday?" may be helpful in determining the patient's processing of information. Verbal response cannot be evaluated if the patient is intubated or has a tracheostomy, and this should be clearly documented.

Alertness is measured by the patient's ability to open the eyes spontaneously or in response to a vocal or noxious stimulus (pressure or pain). Patients with severe neurologic dysfunction cannot do this. The nurse assesses for periorbital edema (swelling around the eyes) or trauma, which may prevent the patient from opening the eyes, and documents any such condition that interferes with eye opening.

Motor response includes spontaneous, purposeful movement (e.g., the awake patient can move all four extremities with equal strength on command), movement only in response to painful stimuli, or abnormal posturing. If the patient is not responding to commands, the motor response is tested by applying a painful stimulus (firm but gentle pressure) to the nail bed or by squeezing a muscle. If the patient attempts to push away or withdraw, the response is recorded as purposeful or appropriate ("Patient withdraws to painful stimulus"). This response is considered purposeful if the patient can cross the midline from one side of the body to the other in response to a painful stimulus. An inappropriate or nonpurposeful response is random and aimless. Posturing may be decorticate or decerebrate (see Fig. 49-2; see also Chapter 48). The most severe neurologic impairment results in flaccidity. The motor response cannot be elicited or assessed when the patient has been given pharmacologic paralyzing agents (i.e., neuromuscular blocking agents).

In addition to LOC, the nurse monitors parameters such as respiratory status, eye signs, and reflexes on an ongoing basis. Table 49-1 summarizes the assessment and the clinical significance of the findings. Body functions (circulation, respiration, elimination, fluid and electrolyte balance) are examined in a systematic and ongoing manner.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Ineffective airway clearance related to inability to maintain an airway due to altered LOC
- Risk for injury related to lack of adaptive and defensive resources due to decreased LOC
- Deficient fluid volume related to inability to take fluids by mouth
- Risk for imbalanced nutrition: less than body requirements related to inability to ingest nutrients to meet metabolic needs
- Impaired oral mucous membrane related to mouth breathing, absence of pharyngeal reflex, and altered fluid intake
- Risk for impaired skin integrity related to prolonged immobility
- Risk for impaired tissue integrity of cornea related to diminished or absent corneal reflex
- Ineffective thermoregulation related to damage to hypothalamic center
- Impaired urinary elimination (incontinence or retention) related to impairment in neurologic sensing and control
- Bowel incontinence related to impairment in neurologic sensing and control and also related to changes in nutritional delivery methods
- Ineffective health maintenance related to neurologic impairment
- Interrupted family processes related to health crisis

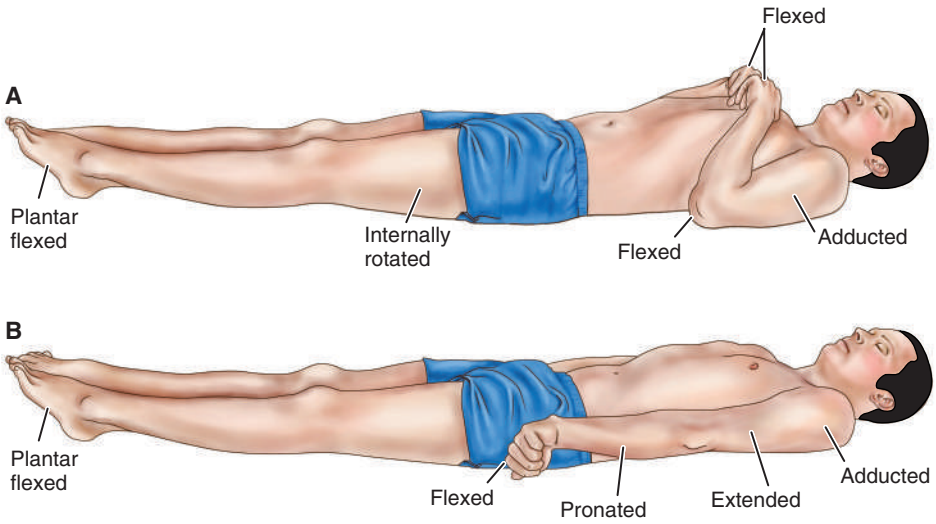


Figure 49-2 • Abnormal posture response to stimuli. **A.** Decorticate posturing and flexion of the upper extremities, internal rotation of the lower extremities, and plantar flexion of the feet. **B.** Decerebrate posturing, involving extension and outward rotation of upper extremities and plantar flexion of the feet. Adapted from Posner, J. B., Saper, C. B., Schiff, N. D., et al. (2007). Plum and Posner's diagnosis of stupor and coma (4th ed.). Oxford, UK: Oxford University Press.

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Respiratory distress or failure
- Pneumonia
- Aspiration
- Pressure ulcer
- Venous thromboembolism (VTE)
- Contractures

Planning and Goals

The patient with altered LOC is subject to all of the complications associated with immobility. Therefore, the goals of care for the patient with altered LOC include maintenance of a clear airway, protection from injury, attainment of fluid volume balance, maintenance of nutritional needs, achievement of intact oral mucous membranes, maintenance of normal skin integrity, absence of corneal irritation, attainment of effective thermoregulation, and effective urinary elimination. Additional goals include bowel continence, restoration of health maintenance, maintenance of intact family or support system, and absence of complications.

Because the protective reflexes of the patient who is unconscious are impaired, the quality of nursing care provided may mean the difference between life and death. The nurse must assume responsibility for the patient until the basic reflexes (coughing, blinking, and swallowing) return and the patient becomes conscious and oriented. Therefore, the major nursing goal is to compensate for the absence of these protective reflexes.

Nursing Interventions

Maintaining the Airway

The most important consideration in managing the patient with altered LOC is to establish an adequate airway and ensure ventilation. Obstruction of the airway is a risk because the epiglottis and tongue may relax, occluding the oropharynx, or the patient may aspirate vomitus or nasopharyngeal secretions.

The accumulation of secretions in the pharynx presents a serious problem. Because the patient cannot swallow and lacks pharyngeal reflexes, these secretions must be removed to eliminate the danger of aspiration. Elevating the head of the bed to 30 degrees helps prevent aspiration. Positioning the patient in a lateral or semiprone position also helps because it allows the jaw and tongue to fall forward, thus promoting drainage of secretions.

Positioning alone is not always adequate, however. Suctioning and oral hygiene may be required. Suctioning is performed to remove secretions from the posterior pharynx and upper trachea. Before and after suctioning, the patient is adequately ventilated to prevent hypoxia (Hickey, 2014). Chest physiotherapy and postural drainage may be initiated to promote pulmonary hygiene, unless contraindicated by the patient's underlying condition. The chest should be auscultated at least every 8 hours to detect adventitious breath sounds or absence of breath sounds.

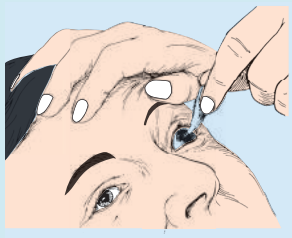
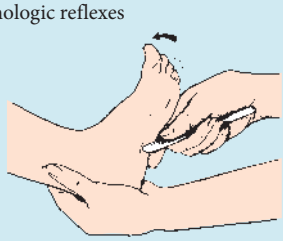
Despite these measures, or because of the severity of impairment, the patient with altered LOC often requires intubation and mechanical ventilation. Nursing actions for the patient who is mechanically ventilated include maintaining the patency of the endotracheal tube or tracheostomy, providing frequent oral care, monitoring arterial blood gas measurements, and maintaining ventilator settings (see Chapter 11).

Protecting the Patient

For the protection of the patient, side rails are padded. Two rails are kept in the raised position during the day and three at night; however, raising all four side rails is considered a restraint by the Joint Commission if the intent is to limit the patient's mobility. Care should be taken to prevent injury from invasive lines and equipment, and other potential sources of injury should be identified, such as restraints, tight dressings, environmental irritants, damp bedding or dressings, and tubes and drains.

Protection also includes ensuring the patient's dignity during altered LOC. Simple measures such as providing privacy and speaking to the patient during nursing care activities preserve the patient's dignity. Not speaking negatively about the patient's condition or prognosis is also important, because patients in a coma may be able to hear. The patient who is comatose has an increased need for advocacy, and the nurse is responsible for seeing that these advocacy needs are met.

TABLE 49-1 Nursing Assessment of the Patient who Is Unconscious

Examination	Clinical Assessment	Clinical Significance
Level of responsiveness or consciousness	Eye opening; verbal and motor responses; pupils (size, equality, reaction to light)	Obeying commands is a favorable response and demonstrates a return to consciousness
Pattern of respiration	Respiratory pattern Cheyne–Stokes respiration Hyperventilation Ataxic respiration with irregularity in depth/rate	Disturbances of respiratory center of brain may result in various respiratory patterns Suggests lesions deep in both hemispheres; area of basal ganglia and upper brainstem Suggests onset of metabolic problem or brainstem damage Ominous sign of damage to medullary center
Eyes Pupils (size, equality, reaction to light) 	Equal, normally reactive pupils Equal or unequal diameter Progressive dilation Fixed dilated pupils	Suggests that coma is toxic or metabolic in origin Helps determine location of lesion Indicates increasing intracranial pressure Indicates injury at level of midbrain
Eye movements	Normally, eyes should move from side to side	Functional and structural integrity of brainstem is assessed by inspection of extraocular movements; usually absent in deep coma
Corneal reflex 	When cornea is touched with a wisp of clean cotton, blink response is normal	Tests cranial nerves V and VII; helps determine location of lesion if unilateral; absent in deep coma
Facial symmetry	Asymmetry (sagging, decrease in wrinkles)	Sign of paralysis
Swallowing reflex	Drooling vs. spontaneous swallowing	Absent in coma Paralysis of cranial nerves X and XII
Neck	Stiff neck Absence of spontaneous neck movement	Subarachnoid hemorrhage, meningitis Fracture or dislocation of cervical spine
Response of extremity to noxious stimuli	Firm pressure on a joint of the upper and lower extremity Observe spontaneous movements	Asymmetric response in paralysis Absent in deep coma
Deep tendon reflexes	Tap patellar and biceps tendons	Brisk response may have localizing value. Asymmetric response in paralysis Absent in deep coma
Pathologic reflexes 	Firm pressure with blunt object on sole of foot, moving along lateral margin and crossing to the ball of foot	Flexion of the toes, especially the great toe, is normal except in newborn Dorsiflexion of toes (especially great toe) indicates contralateral pathology of corticospinal tract (Babinski reflex) Helps determine location of lesion in brain
Abnormal posture	Observation for posturing (spontaneous or in response to noxious stimuli) Flaccidity with absence of motor response Decorticate posture (flexion and internal rotation of forearms and hands) Decerebrate posture (extension and external rotation)	Deep extensive brain lesion Seen with cerebral hemisphere pathology and metabolic depression of brain function Decerebrate posturing indicates deeper and more severe dysfunction than does decorticate posturing; implies brain pathology; poor prognostic sign

Nursing Alert: If the patient begins to emerge from unconsciousness, every measure that is available and appropriate for calming and quieting the patient should be used. Any form of restraint is likely to be countered with resistance, leading to self-injury or to a dangerous increase in ICP. Therefore, physical restraints are avoided, if possible; a written prescription must be obtained if their use is essential for the patient's well-being.

Maintaining Fluid Balance and Managing Nutritional Needs

Hydration status is assessed by examining tissue turgor and mucous membranes, assessing intake and output trends, and analyzing laboratory data. Fluid needs are met initially by administering the required IV fluids. However, IV solutions (and blood component therapy) for patients with intracranial conditions must be given slowly. If they are given too rapidly, they can increase ICP. The quantity of fluids given may be restricted to minimize the possibility of cerebral edema.

If the patient does not recover quickly and sufficiently enough to take adequate fluids and calories by mouth, a feeding or gastrostomy tube will be inserted for the administration of fluids and enteral feedings. Research suggests that patients fed within 48 hours of injury have improved outcomes over those in whom nutrition is delayed (Wang, Dong, Han, et al., 2013).

Providing Mouth Care

The mouth is inspected for dryness, inflammation, and crusting. The patient who is unconscious requires careful oral care, because there is a risk of parotitis if the mouth is not kept scrupulously clean. The mouth is cleansed and rinsed carefully to remove secretions and crusts and to keep the mucous membranes moist. A thin coating of petrolatum on the lips prevents drying, cracking, and encrustations. If the patient has an endotracheal tube, the tube should be moved to the opposite side of the mouth daily to prevent ulceration of the mouth and lips. If the patient is intubated and mechanically ventilated, good oral care is also necessary. Research suggests that comprehensive mouth care with antiseptic such as chlorhexidine and head of bed elevation decreases ventilator-associated pneumonia and improves the oral health in patients who are intubated (Munro & Ruggiero, 2014).

Maintaining Skin and Joint Integrity

Preventing skin breakdown requires continuing nursing assessment and intervention. Special attention is given to patients who are unconscious, because they cannot respond to external stimuli. Assessment includes a regular schedule of turning to avoid pressure, which can cause breakdown and necrosis of the skin. Turning also provides kinesthetic (sensation of movement), proprioceptive (awareness of position), and vestibular (equilibrium) stimulation. After turning, the patient is carefully repositioned to prevent ischemic necrosis over pressure areas. Dragging or pulling the patient up in bed must be avoided, because this creates a shearing force and friction on the skin surface.

Maintaining correct body position is important; equally important is passive exercise of the extremities to prevent contractures. The use of splints or foam boots aids in the prevention of footdrop and eliminates the pressure of bedding on the toes. The use of trochanter rolls to support the hip joints keeps the legs in proper alignment. The arms are in abduction, the fingers lightly flexed, and the hands in slight supination. The heels of the feet are assessed for pressure areas. Specialty beds, such as fluidized or low-air-loss beds, may be used to decrease pressure on bony prominences (Hickey, 2014).

Preserving Corneal Integrity

Some patients who are unconscious have their eyes open and have inadequate or absent corneal reflexes. The cornea may become irritated, dry, or scratched, leading to ulceration. The eyes may be cleansed with cotton balls moistened with sterile normal saline to remove debris and discharge. If artificial tears are prescribed, they may be instilled every 2 hours. Periorbital edema often occurs after cranial surgery. If cold compresses are prescribed, care must be exerted to avoid contact with the cornea. Eye patches should be used cautiously because of the potential for corneal abrasion from contact with the patch.

Maintaining Body Temperature

High fever in the patient who is unconscious may be caused by infection of the respiratory or urinary tract, drug reactions, or damage to the hypothalamic temperature-regulating center. A slight elevation of temperature may be caused by dehydration. The environment can be adjusted, depending on the patient's condition, to promote a normal body temperature. If body temperature is elevated, a minimum amount of bedding is used. The room may be cooled to 18.3°C (65°F). However, if the patient is an older adult and does not have an elevated temperature, a warmer environment is needed.

Because of damage to the temperature-regulating center in the brain or severe intracranial infection, patients who are unconscious often develop very high temperatures. Such temperature elevations must be controlled, because the increased metabolic demands of the brain can exceed cerebral circulation and oxygen delivery, potentially resulting in cerebral deterioration (Hickey, 2014). Studies suggest that hyperthermia may contribute to poor outcome after brain injury but not through a decreased brain oxygen level (Madden & DeVon, 2015). Persistent hyperthermia with no identified clinical source of infection indicates brainstem damage and a poor prognosis.

Nursing Alert: The body temperature of a patient who is unconscious is never taken by mouth. Rectal, tympanic (if not contraindicated), or core temperature measurement is preferred to the less accurate axillary temperature.

Strategies for reducing fever include:

- Removing all bedding over the patient (with the possible exception of a light sheet, towel, or small drape)
- Administering acetaminophen/paracetamol or ibuprofen as prescribed
- Giving cool sponge baths
- Using a hypothermia blanket
- Monitoring temperature frequently to assess the patient's response to the therapy and to prevent an excessive decrease in temperature and shivering

Preventing Urinary Retention

The patient with an altered LOC is often incontinent or has urinary retention. The bladder is palpated or scanned at intervals to determine whether urinary retention is present, because a full bladder may be an overlooked cause of overflow incontinence. A portable bladder ultrasound instrument is a useful tool in bladder management and retraining programs.

If the patient is not voiding, a program of intermittent catheterization should be devised in order to reduce the patient's

risk of urinary tract infection. A catheter may be inserted during the acute phase of illness to monitor urinary output. Because catheters are a major cause of urinary tract infection, the patient is observed for fever and cloudy urine. The area around the urethral orifice is inspected for drainage and cleansed routinely. The urinary catheter is usually removed if the patient has a stable cardiovascular system and if no diuresis, sepsis, or voiding dysfunction existed before the onset of coma. Although many patients who are unconscious urinate spontaneously after catheter removal, the bladder should be palpated or scanned with a portable ultrasound device periodically for urinary retention (see Chapter 43, Fig. 43-8).

An external catheter (condom catheter) for the male patient and absorbent pads for the female patient can be used for patients who are unconscious and can urinate spontaneously, although involuntarily. As soon as consciousness is regained, a bladder training program is initiated (Hickey, 2014). The patient who is incontinent is monitored frequently for skin irritation and skin breakdown. Appropriate skin care is implemented to prevent these complications.

Promoting Bowel Function

The abdomen is assessed for distention by listening for bowel sounds and measuring the girth of the abdomen with a tape measure. There is a risk of diarrhea from infection, antibiotic agents, and hyperosmolar fluids. Frequent loose stools may also occur with fecal impaction. Commercial fecal collection bags are available for patients with fecal incontinence (see Chapter 18, Fig. 18-1).

Immobility and lack of dietary fiber can cause constipation. The nurse monitors the number and consistency of bowel movements and performs a rectal examination for signs of fecal impaction. Stool softeners may be prescribed and can be given with tube feedings. To facilitate bowel emptying, a glycerin suppository may be indicated. The patient may require an enema every other day to empty the lower colon.

Restoring Health Maintenance

Once increased ICP is not a problem, the nurse assists the patient and family to restore the health of the patient who is unconscious. This involves using auditory, visual, olfactory, gustatory, tactile, and kinesthetic activities to stimulate the patient emerging from coma (Megha, Harpreet, & Nayeem, 2013). Efforts are made to restore the sense of daily rhythm by maintaining usual day and night patterns for activity and sleep. The nurse touches and talks to the patient and encourages family members and friends to do so. Communication is extremely important and includes touching the patient and spending enough time with the patient to become sensitive to their needs. It is also important to avoid making any negative comments about the patient's status or prognosis in the patient's presence.

The nurse orients the patient to time and place at least once every 8 hours. Sounds from the patient's usual environment may be introduced using a tape recorder. Family members can read to the patient from a favorite book and may suggest radio and television programs that the patient previously enjoyed as a means of enriching the environment and providing familiar input.

When arousing from coma, many patients experience a period of agitation, indicating that they are becoming more aware of their surroundings but still cannot react or communicate in an appropriate fashion. Although this is disturbing for many family members, it is actually a positive clinical sign. At this time, it is necessary to minimize stimulation by limiting background noises, having only one person speak to the patient at a time, giving the patient a longer period of time to respond, and allowing for frequent rest or quiet times. After the patient has regained consciousness, videotaped family or social events may assist the patient in recognizing family and friends and allow him or her to experience missed events.

Programs of sensory stimulation for patients with brain injury have been developed in an effort to improve outcomes. Although these are controversial programs with inconsistent results, some research supports the concept of providing structured stimulation (Megha et al., 2013).

Meeting the Family's Needs

The family of the patient with altered LOC may be thrown into a sudden state of crisis and go through the process of severe anxiety, denial, anger, remorse, grief, and reconciliation. Depending on the disorder that caused the altered LOC and the extent of the patient's recovery, the family may be unprepared for the changes in the cognitive and physical status of their loved one. If the patient has significant residual deficits, the family may require considerable time, assistance, and support to come to terms with these changes. To help family members mobilize resources and coping skills, the nurse reinforces and clarifies information about the patient's condition, encourages the family to be involved in care, and listens to and encourages ventilation of feelings and concerns while supporting decision making about management and placement after hospitalization. Families may benefit from participation in support groups offered through the hospital, rehabilitation facility, or community organizations.

The family may need to face the death of their loved one. The patient with a neurologic disorder is often pronounced brain dead before the heart stops beating. The term brain death describes irreversible loss of all functions of the entire brain and absence of brainstem reflexes (Wijdicks, 2013). The term may be misleading to the family because, although brain function has ceased, the patient appears to be alive, with the heart rate and blood pressure sustained by vasoactive medications and breathing continued by mechanical ventilation. When discussing a patient who is brain dead with family members, it is important to provide accurate, timely, understandable, and consistent information. See Chapter 59 for discussion of end-of-life care.

Monitoring and Managing Potential Complications

Pneumonia, aspiration, and respiratory failure are potential complications in any patient who has a depressed LOC and who cannot protect the airway or turn, cough, and take deep breaths. The longer the period of unconsciousness, the greater the risk of pulmonary complications.

Vital signs and respiratory function are monitored closely to detect any signs of respiratory failure or distress. Complete blood count and arterial blood gas measurements are assessed to determine whether there are adequate red blood cells to carry oxygen and whether ventilation is effective. Chest physiotherapy and suctioning are initiated to prevent respiratory complications such as pneumonia. Oral care interventions are performed for patients receiving mechanical ventilation to maintain oral health and decrease the incidence of pneumonia (Kiyoshi-Teo & Blegen, 2015). If pneumonia develops, cultures are obtained to identify the organism so that appropriate antibiotic agents can be given.

The patient with altered LOC is monitored closely for evidence of impaired skin integrity, and strategies to prevent skin breakdown and pressure ulcers are continued through all phases of care, including hospitalization, rehabilitation, and home care. Factors that contribute to impaired skin integrity (e.g., incontinence, inadequate dietary intake, pressure on bony prominences, edema) are addressed. If pressure ulcers develop, strategies to promote healing are undertaken. Care is taken to prevent bacterial contamination of pressure ulcers, which may lead to sepsis and septic shock.

The patient should also be monitored for signs and symptoms of VTE, which may manifest as a deep vein thrombosis (DVT) or pulmonary embolism (PE). Prophylaxis with subcutaneous heparin or low–molecular-weight heparin (dalteparin [Fragmin], danaparoid [Orgaran]) as well as antiembolism stockings or pneumatic compression devices are prescribed according to the patient's risk factors for thrombosis and bleeding (Foreman, Schmalz, & Griessenauer, 2014). The nurse observes for signs and symptoms of DVT or PE.

Patients with a prolonged decrease in LOC are at risk for developing contractures. During acute care, the patient is turned every 2 hours and passive range of motion performed at least twice a day. Splints, provided by occupational therapy, are applied to the hands and feet in a rotating manner to maintain functional joint alignment. Hand splints have been reported to be safe and beneficial for patients in decreasing spasticity and improving hand opening (Thibault, Deltombe, Wannez, et al., 2015). See Chapter 38 for further information on prevention of contractures.

Evaluation

Expected patient outcomes may include:

1. Maintains clear airway and demonstrates appropriate breath sounds
2. Experiences no injuries
3. Attains or maintains adequate fluid balance and nutritional status
   a. Has no clinical signs or symptoms of dehydration
   b. Demonstrates normal range of serum electrolytes
   c. Has no clinical signs or symptoms of overhydration or malnutrition
4. Achieves healthy oral mucous membranes
5. Maintains normal skin integrity
6. Has no corneal irritation
7. Attains or maintains thermoregulation
8. Has no urinary retention
9. Has no diarrhea or fecal impaction
10. Receives appropriate sensory stimulation
11. Has family members who cope with crisis
    a. Verbalize fears and concerns
    b. Participate in patient's care and provide sensory stimulation by talking and touching
12. Is free of complications
    a. Has arterial blood gas values or oxygen saturation levels within normal range
    b. Displays no signs or symptoms of pneumonia
    c. Exhibits intact skin over pressure areas
    d. Does not develop VTE such as DVT or PE

INCREASED INTRACRANIAL PRESSURE

The rigid cranial vault contains brain tissue (1400 g), blood (75 mL), and CSF (75 mL). The volume and pressure of these three components are usually in a state of equilibrium and produce the ICP. ICP is usually measured in the lateral ventricles, with the normal pressure being 0 to 10 mm Hg, and 15 mm Hg being the upper limit of normal (Hickey, 2014).

The Monro–Kellie hypothesis, also known as the Monro–Kellie doctrine, explains the dynamic equilibrium of cranial contents. The hypothesis states that because of the limited space for expansion within the skull, an increase in any one of the components causes a change in the volume of the others. Because brain tissue has limited space to expand, compensation typically is accomplished by displacing or shifting CSF, increasing the absorption or diminishing the production of CSF, or decreasing cerebral blood volume. Without such changes, ICP begins to rise. Under normal circumstances, minor changes in blood volume and CSF volume occur constantly as a result of alterations in intrathoracic pressure (coughing, sneezing, straining), posture, blood pressure, and systemic oxygen and carbon dioxide levels (Hickey, 2014).

Pathophysiology

Increased ICP affects many patients with acute neurologic conditions because pathologic conditions alter the relationship between intracranial volume and ICP. Although elevated ICP is most commonly associated with head injury, it also may be seen as a secondary effect in other conditions, such as brain tumors, subarachnoid hemorrhage, and toxic and viral encephalopathies. Increased ICP from any cause decreases cerebral perfusion, stimulates further swelling (edema), and may shift brain tissue, resulting in herniation—a dire and frequently fatal event. A flowchart for pathophysiology of increased ICP is presented in Figure 49-3.

Decreased Cerebral Blood Flow

Increased ICP may reduce cerebral blood flow, resulting in ischemia and cell death. In the early stages of cerebral ischemia, the vasomotor centers are stimulated and the systemic pressure rises to maintain cerebral blood flow. Usually, this is accompanied by a slow bounding pulse and respiratory irregularities. These changes in blood pressure, pulse, and respiration are important clinically because they suggest increased ICP.

The concentration of carbon dioxide in the blood and in the brain tissue also plays a role in the regulation of cerebral blood flow. An increase in the partial pressure of arterial carbon dioxide ($PaCO_2$) causes cerebral vasodilation, leading to increased cerebral blood flow and increased ICP. A decrease in $PaCO_2$ has a vasoconstrictive effect, limiting blood flow to the brain. Decreased venous outflow may also increase cerebral blood volume, thus raising ICP.

Cerebral Edema

Cerebral edema or swelling is defined as an abnormal accumulation of water or fluid in the intracellular space, extracellular space, or both, associated with an increase in the volume of brain tissue. Edema can occur in the gray, white, or interstitial matter. As brain tissue swells within the rigid skull, several mechanisms

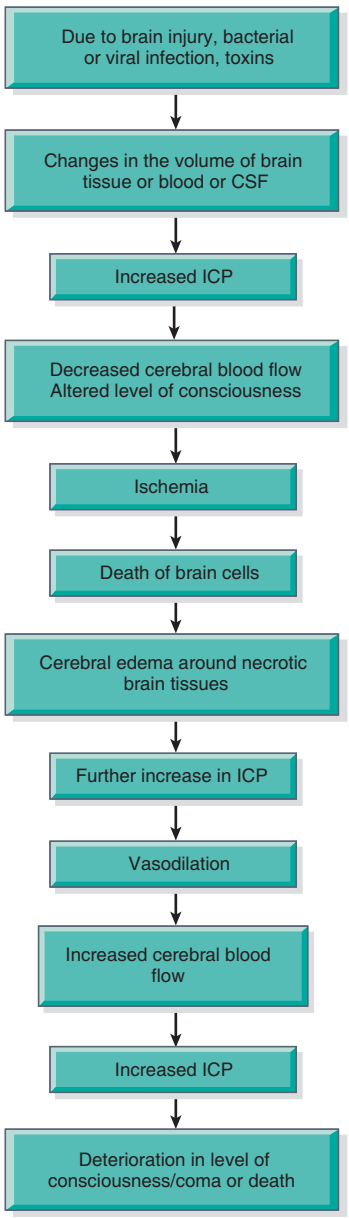


Figure. 49-3 • Pathophysiology of increased intracranial pressure.

attempt to compensate for the increasing ICP. These compensatory mechanisms include autoregulation as well as decreased production and flow of CSF. **Autoregulation** refers to the brain's ability to change the diameter of its blood vessels to maintain a constant cerebral blood flow during alterations in systemic blood pressure. This mechanism can be impaired in patients who are experiencing a pathologic and sustained increase in ICP.

Cerebral Response to Increased Intracranial Pressure

As ICP rises, compensatory mechanisms in the brain work to maintain blood flow and prevent tissue damage. The brain can maintain a steady perfusion pressure if the arterial systolic blood pressure is 50 to 150 mm Hg and the ICP is less than 40 mm Hg. Changes in ICP are closely linked with cerebral perfusion pressure (CPP). The CPP is calculated by subtracting the ICP from the mean arterial pressure (MAP). For example, if the MAP is 100 mm Hg and the ICP is 15 mm Hg, then the CPP is 85 mm Hg. The normal CPP is 70 to 100 mm Hg (Hickey, 2014). As ICP rises and the autoregulatory mechanism of the brain is overwhelmed, the CPP can increase to greater than 100 mm Hg or decrease to less than 50 mm Hg. Patients with a CPP of less than 50 mm Hg experience irreversible neurologic damage. Therefore, the CPP must be maintained at 70 to 80 mm Hg to ensure adequate blood flow to the brain. If ICP is equal to MAP, cerebral circulation ceases.

A clinical phenomenon known as the Cushing's response (or Cushing's reflex) is seen when cerebral blood flow decreases significantly. When ischemic, the vasomotor center triggers an increase in arterial pressure in an effort to overcome the increased ICP. A sympathetically mediated response causes an increase in the systolic blood pressure with a widening of the pulse pressure and cardiac slowing. This response is seen clinically as an increase in systolic blood pressure, widening of the pulse pressure, and reflex slowing of the heart rate. It is a late sign requiring immediate intervention; however, perfusion may be recoverable if the Cushing's response is treated rapidly.

At a certain point, the brain's ability to autoregulate becomes ineffective and decompensation (ischemia and infarction) begins. When this occurs, the patient exhibits significant changes in mental status and vital signs. The bradycardia, hypertension, and bradypnea associated with this deterioration are known as Cushing's triad, which is a grave sign. At this point, herniation of the brainstem and occlusion of the cerebral blood flow occur if therapeutic intervention is not initiated. Herniation refers to the shifting of brain tissue from an area of high pressure to an area of lower pressure (see Fig. 49-4). The herniated tissue exerts pressure on the brain area into which it has shifted, which interferes with the blood supply in that area.

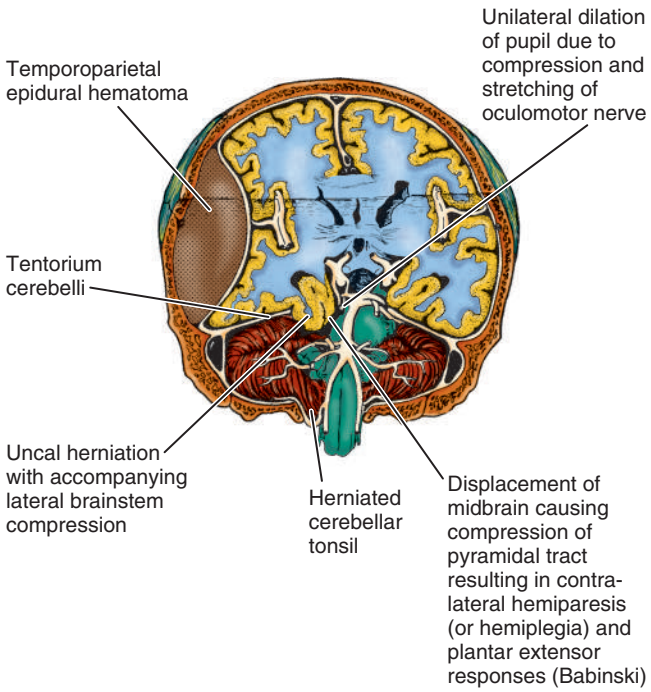


Figure 49-4 • Cross-section of the brain showing herniation of part of the temporal lobe through the tentorium as a result of a temporoparietal epidural hematoma. Reprinted with permission from Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Cessation of cerebral blood flow results in cerebral ischemia, infarction, and brain death.

Clinical Manifestations

If ICP increases to the point at which the brain's ability to adjust has reached its limits, neural function is impaired; this may be manifested at first by clinical changes in LOC and later by abnormal respiratory and vasomotor responses.

Nursing Alert: The earliest sign of increasing ICP is a change in LOC. Agitation, slowing of speech, and delay in response to verbal suggestions may be early indicators.

Any sudden change in the patient's condition, such as restlessness (without apparent cause), confusion, or increasing drowsiness, has neurologic significance. These signs may result from compression of the brain due to swelling from hemorrhage or edema, an expanding intracranial lesion (hematoma or tumor), or a combination of both.

As ICP increases, the patient becomes stuporous, reacting only to loud or painful stimuli. At this stage, serious impairment of brain circulation is probably taking place, and immediate intervention is required. As neurologic function deteriorates further, the patient becomes comatose and exhibits abnormal motor responses in the form of decortication (abnormal flexion of the upper extremities and extension of the lower extremities), decerebration (extreme extension of the upper and lower extremities), or flaccidity (see Fig. 49-2). If the coma is profound and irreversible with no known confounding factors, brainstem reflexes are absent, and respirations are impaired or absent, the patient may be evaluated for brain death (Wijdicks, 2013).

Assessment and Diagnostic Findings

The diagnostic studies used to determine the underlying cause of increased ICP are discussed in detail in Chapter 48. The most common diagnostic tests are CT scanning and MRI. The patient may also undergo cerebral angiography, PET, or SPECT. Transcranial Doppler studies provide information about cerebral blood flow. The patient with increased ICP may also undergo electrophysiologic monitoring to observe cerebral blood flow indirectly. Evoked potential monitoring measures the electrical potentials produced by nerve tissue in response to external stimulation (auditory, visual, or sensory). Lumbar puncture is avoided in patients with increased ICP, because the sudden release of pressure in the lumbar area can cause the brain to herniate (Hickey, 2014). See Chapter 48 for further discussion of lumbar puncture and other diagnostic tests.

Complications

Complications of increased ICP include brainstem herniation, diabetes insipidus, and syndrome of inappropriate antidiuretic hormone (SIADH).

Brainstem herniation results from an excessive increase in ICP in which the pressure builds in the cranial vault and the brain tissue presses down on the brainstem. This increasing pressure on the brainstem results in cessation of blood flow to the brain, leading to irreversible brain anoxia and brain death.

Neurogenic diabetes insipidus is the result of decreased secretion of antidiuretic hormone (ADH). The patient has excessive urine output, decreased urine osmolality, and serum hyperosmolarity (Grossman & Porth, 2014). Therapy consists of administration of fluids, electrolyte replacement, and administration of a synthetic vasopressin (desmopressin [DDAVP]). See Chapters 7 and 32 for a discussion of diabetes insipidus.

SIADH is the result of increased secretion of ADH. The patient becomes volume overloaded, urine output diminishes, and serum sodium concentration becomes dilute. Treatment of SIADH includes fluid restriction (less than 800 mL/day with no free water), which is usually sufficient to correct the hyponatremia. In severe cases, careful administration of a 3% hypertonic saline solution may be therapeutic (Aylwin, Burst, Peri, et al., 2015). The change in serum sodium concentration should not exceed a correction rate of approximately 1.3 mEq/L/hr. See Chapters 7 and 32 for further discussion of SIADH.

Medical Management

Increased ICP is a true emergency and must be treated promptly. Invasive monitoring of ICP is an important component of management. Immediate management to relieve increased ICP requires decreasing cerebral edema, lowering the volume of CSF, or decreasing cerebral blood volume while maintaining cerebral perfusion. These goals are accomplished by administering osmotic diuretics, restricting fluids, draining CSF, controlling fever, maintaining systemic blood pressure and oxygenation, and reducing cellular metabolic demands. See Chapter 51 for a discussion of the management of increased ICP.

Monitoring Intracranial Pressure and Cerebral Oxygenation

The purposes of ICP monitoring are to identify increased pressure early in its course (before cerebral damage occurs), to quantify the degree of elevation, to initiate appropriate treatment, to provide access to CSF for sampling and drainage, and to evaluate the effectiveness of treatment. ICP can be monitored with the use of an intraventricular catheter (ventriculostomy), a subarachnoid bolt, an epidural or subdural catheter, or a fiberoptic transducer-tipped catheter placed in the subdural space or in the ventricle (see Fig. 49-5).

When a ventriculostomy or intraventricular catheter monitoring device is used for monitoring ICP, a fine-bore catheter is inserted into a lateral ventricle, preferably in the nondominant hemisphere of the brain (American Association of Neuroscience Nurses [AANN], 2012). The catheter is connected by a fluid-filled system to a transducer, which records the pressure in the form of an electrical impulse. In addition to obtaining continuous ICP recordings, the ventricular catheter allows CSF to drain, particularly during acute increases in pressure. The ventriculostomy can also be used to drain blood from the ventricle. Continuous drainage of CSF under pressure control is an effective method of treating intracranial hypertension. Another advantage of a ventricular catheter is access for the intraventricular administration of medications and the occasional instillation of air or a contrast agent for ventriculography. Complications associated with its use include infection, meningitis, ventricular collapse, occlusion of the catheter by brain tissue or blood, and problems with the monitoring system.

The subarachnoid screw or bolt is a hollow device that is inserted through the skull and dura mater into the cranial

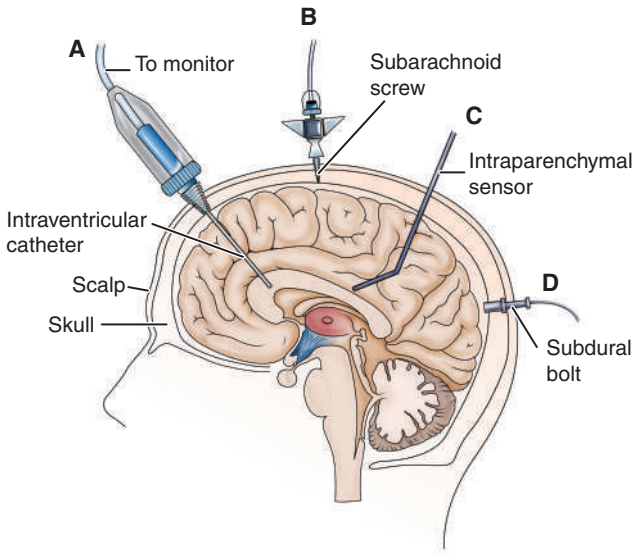


Figure 49-5 • Intracranial pressure monitoring. A device may be placed in the ventricle (**A**), the subarachnoid space (**B**), the intraparenchymal space (**C**), or the subdural space (**D**).

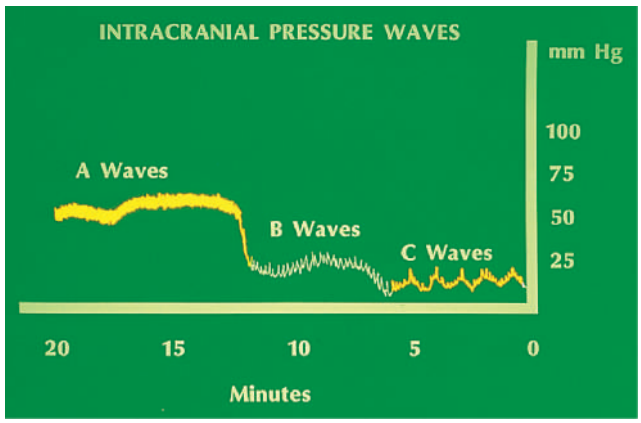


Figure 49-6 • Intracranial pressure waves. Composite diagram of A (plateau) waves, which indicate cerebral ischemia; B waves, which indicate intracranial hypertension and variations in the respiratory cycle; and C waves, which relate to variations in systemic arterial pressure and respirations.

subarachnoid space (Hickey, 2014). It has the advantage of not requiring a ventricular puncture. The subarachnoid screw is attached to a pressure transducer, and the output is recorded on an oscilloscope. The hollow screw technique also has the advantage of avoiding complications from brain shift and small ventricle size. Complications include infection and blockage of the screw by clot or brain tissue, which leads to a loss of pressure tracing and a decrease in accuracy at high ICP readings.

An epidural monitor uses a pneumatic flow sensor to detect ICP. The epidural ICP monitoring system has a low incidence of infection and complications and appears to read pressures accurately. Calibration of the system is maintained automatically, and abnormal pressure waves trigger an alarm system. One disadvantage of the epidural catheter is the inability to withdraw CSF for analysis.

A fiberoptic monitor, or transducer-tipped catheter, is an alternative to other intraventricular, subarachnoid, and subdural systems (Sandsmark, Kumar, Park, et al., 2012). The miniature transducer reflects pressure changes, which are converted to electrical signals in an amplifier and displayed on a digital monitor. The catheter can be inserted into the ventricle, subarachnoid space, subdural space, or brain parenchyma or under a bone flap. If inserted into the ventricle, it can also be used in conjunction with a CSF drainage device.

Interpreting Intracranial Pressure Waveforms

Waves of high pressure and troughs of relatively normal pressure indicate changes in ICP. Waveforms are captured and recorded on an oscilloscope. These waves have been classified as A waves (plateau waves), B waves, and C waves (see Fig. 49-6). The plateau waves (A waves) are transient, paroxysmal, recurring elevations of ICP that may last 5 to 20 minutes and range in amplitude from 40 to 100 mm Hg (Dias, Maia, Cerejo, et al., 2014). Plateau waves have clinical significance and indicate changes in vascular volume within the intracranial compartment that are beginning to compromise cerebral perfusion. The A waves may increase in amplitude and frequency, reflecting cerebral ischemia and brain damage that can occur before overt signs and symptoms of raised ICP are seen clinically. B waves are shorter (30 seconds to 2 minutes) and have smaller amplitude (up to 50 mm Hg). They have less clinical significance, but if seen in a series in a patient with depressed consciousness, they may precede the appearance of A waves. B waves may be seen in patients with intracranial hypertension and decreased intracranial compliance. C waves are small, rhythmic oscillations with frequencies of 4 to 8 per minute and appear to be related to rhythmic variations of the systemic arterial blood pressure and respirations (Hickey, 2014).

Other Neurologic Monitoring Systems

Another trend in neurologic monitoring is microdialysis of the patient with a brain injury (de Lima Oliveira, Kairalla, Fonoff, et al., 2014). Cortical probes are placed near the injured area and are used to measure levels of glutamate, lactate, pyruvate, and glucose, substances that reflect the metabolic function of the brain. Some researchers theorize that direct measurements of glucose and energy by-products in the brain will lead to better management of these patients. Although cerebral microdialysis has reduced the mortality of patients who are brain injured, more study is needed to link it to improved outcomes (de Lima Oliveira et al., 2014).

An additional trend is monitoring of cerebral oxygenation through monitoring of the oxygen saturation in the jugular venous bulb ($SjvO_2$) or via a catheter in the brain. Cerebral oxygenation is thought to be important because changes in cerebral perfusion may reflect an increase in ICP. Readings taken from a catheter residing in the jugular outflow tract allow for a comparison of arterial and venous oxygen saturation, and the balance of cerebral oxygen supply and demand is demonstrated. Venous jugular desaturations can reflect early cerebral ischemia, alerting the clinician before an increase in ICP occurs. Minimizing cerebral desaturations can potentially improve outcomes (Sandsmark et al., 2012). This type of monitoring is now widely available and has been successfully used to identify secondary brain insults. A limiting factor is that this saturation reflects overall perfusion of the brain rather than that of a specific injured area (Oddo, Bosel, & Participants in the International Multidisciplinary Consensus Conference on Multimodality Monitoring, 2014).

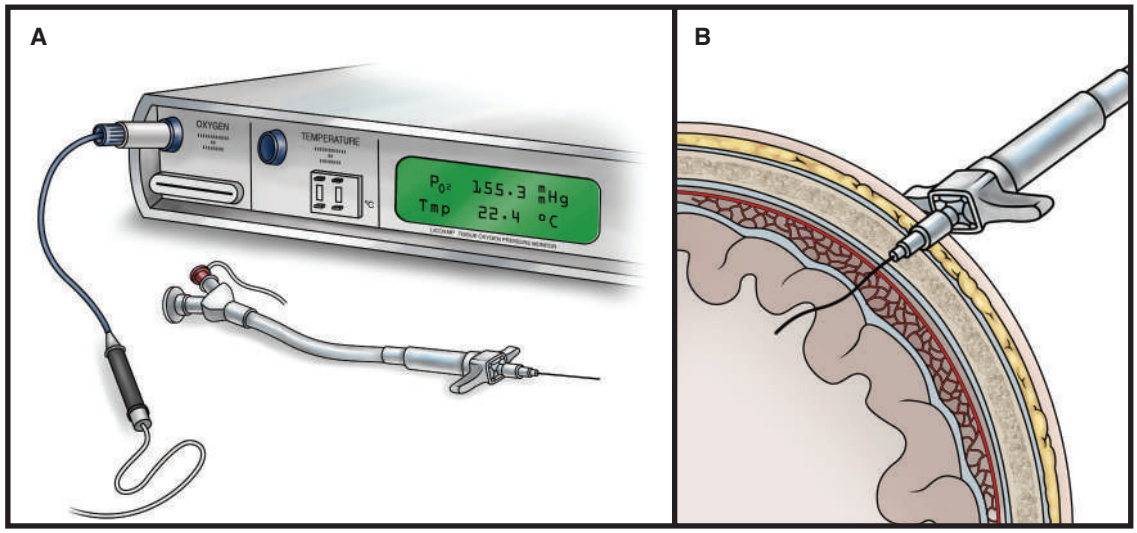


Figure 49-7 • Licox catheter system. **A.** The brain tissue oxygen catheter and monitor. **B.** Placement of the catheter in brain white matter. Redrawn with permission of Integra NeuroSciences, Plainsboro, NJ.

Another method of measuring cerebral oxygenation and temperature is by inserting a fiberoptic catheter into the brain matter (Oddo et al., 2014). The most common system is Licox (see Fig. 49-7). The system includes a monitor with a screen for the display of oxygen and temperature values and cables that connect to the monitoring probes in the brain (Hickey, 2014).

Decreasing Cerebral Edema

Osmotic diuretics such as mannitol and hypertonic saline (3%) may be given to dehydrate the brain tissue and reduce cerebral edema (Ong, Keyrouz, & Diringer, 2015). They act by drawing water across intact membranes, thereby reducing the volume of the brain and extracellular fluid. An indwelling urinary catheter is usually inserted to monitor urinary output and to manage the resulting diuresis. If the patient is receiving osmotic diuretics, serum osmolality and electrolytes should be determined to assess hydration status. If a brain tumor is the cause of the increased ICP, corticosteroids (e.g., dexamethasone) help reduce the edema surrounding the tumor.

Another method for decreasing cerebral edema is fluid restriction (Hickey, 2014). Limiting overall fluid intake leads to dehydration and hemoconcentration, which draws fluid across the osmotic gradient and decreases cerebral edema. Conversely, overhydration of the patient with increased ICP is avoided, because it increases cerebral edema.

Researchers have long hypothesized that lowering body temperature would decrease cerebral edema by reducing the oxygen and metabolic requirements of the brain, thus protecting the brain from continued ischemia. If body metabolism can be reduced by lowering the body temperature, the collateral circulation in the brain may be able to provide an adequate blood supply to the brain. The effect of hypothermia on ICP requires more study; thus far, induced hypothermia has not consistently been shown to be beneficial for patients with brain injury. Inducing and maintaining hypothermia is a major clinical treatment and requires knowledge and skilled nursing observation and management. The type and length of rewarming techniques after hypothermia may also be factors in the outcome of patients with neurologic injuries (Andrews, Sinclair, Rodriguez, et al., 2015); (Madden & DeVon, 2015).

Maintaining Cerebral Perfusion

Cardiac output may be manipulated to provide adequate perfusion to the brain. Improvements in cardiac output are made using fluid volume and inotropic agents such as dobutamine (Dobutrex) and norepinephrine (Levophed). The effectiveness of the cardiac output is reflected in the CPP, which is maintained at greater than 70 mm Hg (Oddo et al., 2014). A lower CPP indicates that the cardiac output is insufficient to maintain adequate cerebral perfusion. $SjvO_2$ and Licox, described earlier, assist in monitoring cerebral perfusion.

Decompressive hemicraniectomy may also be considered as a surgical strategy to assist in the management of refractory intracranial hypertension. The removal of a part of the skull allows the brain to expand without the pressure constraints exerted by the cranial vault. Complications of this procedure include infection and increased potential for injury to the unprotected underlying brain structures. Once the patient is no longer at risk for increased ICP, the bone flap may be surgically replaced (Alali, Naimark, Wilson, et al., 2014).

Reducing Cerebrospinal Fluid and Intracranial Blood Volume

CSF drainage is frequently performed, because the removal of CSF with a ventriculostomy drain can dramatically reduce ICP and restore CPP. Caution should be used in draining CSF, however, because excessive drainage may result in collapse of the ventricles and herniation. The reduction in $PaCO_2$ may result in hypoxia, ischemia, and an increase in cerebral lactate levels. Maintaining the $PaCO_2$ at greater than 30 mm Hg may prove beneficial (Hickey, 2014).

Controlling Fever

Preventing a temperature elevation is critical, because fever increases cerebral metabolism and the rate at which cerebral edema forms. Strategies to reduce body temperature include administration of antipyretic medications, as prescribed, and the use of a hypothermia blanket. Additional strategies for reducing fever were discussed previously in the Nursing Process section on altered LOC. The patient's temperature is monitored

closely, and the patient is observed for shivering, which should be avoided because it is associated with increased oxygen consumption, increased levels of circulating catecholamines, and increased vasoconstriction. Shivering is associated with decreased levels of brain oxygenation; however, the association between shivering and neurologic outcome is unknown.

Maintaining Oxygenation and Reducing Metabolic Demands

Arterial blood gases and pulse oximetry are monitored to ensure that systemic oxygenation remains optimal. Metabolic demands may be reduced through the administration of high doses of barbiturates if the patient is unresponsive to conventional treatment. The mechanism by which barbiturates decrease ICP and protect the brain is uncertain, but the resultant comatose state is thought to reduce the metabolic requirements of the brain, thus providing cerebral protection (Alali et al., 2014).

Another method of reducing cellular metabolic demand and improving oxygenation is the administration of medications causing sedation. The patient who receives these agents cannot move; this decreases the metabolic demands and results in a decrease in cerebral oxygen demand. The patient cannot respond to or report pain either. The most common agents used for sedation are pentobarbital (Nembutal), thiopental (Pentothal), propofol (Diprivan), and dexmedetomidine (Precedex) (Majdan, Mauritz, Wilbacher, et al., 2013); (Wang, Ji, Fen, et al., 2013).

If sedative agents are used, the ability to perform serial neurologic assessments is lost. Therefore, other monitoring tools are needed to assess the patient's status and response to therapy. Important parameters that must be assessed include ICP, blood pressure, heart rate, respiratory rate, and the patient's response to ventilator therapy (e.g., "fighting or bucking the ventilator"). The level of pharmacologic paralysis is adjusted based on serum levels of the medications given and the assessed parameters. Potential complications of these medications include hypotension caused by decreased sympathetic tone and myocardial depression.

Patients receiving high doses of barbiturates or pharmacologic sedatives require continuous cardiac monitoring, endotracheal intubation, mechanical ventilation, and arterial pressure monitoring, as well as ICP monitoring.

NURSING PROCESS

The Patient with Increased Intracranial Pressure

Assessment

Initial assessment of the patient with increased ICP includes obtaining a history of events leading to the present illness and the pertinent past medical history. It is usually necessary to obtain this information from family or friends. The neurologic examination should be as complete as the patient's condition allows. It includes an evaluation of mental status, LOC, cranial nerve function, cerebellar function (balance and coordination), reflexes, and motor and sensory function. Because the patient is critically ill, ongoing assessment is more focused, including pupil checks, (see Table 49-1) assessment of selected cranial nerves, frequent measurements of vital signs and ICP, and the use of the Glasgow Coma Scale.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses include the following:

- Ineffective airway clearance related to diminished protective reflexes (cough, gag)
- Ineffective breathing patterns related to neurologic dysfunction (brainstem compression, structural displacement)
- Risk for ineffective cerebral tissue perfusion related to the effects of increased ICP
- Deficient fluid volume related to fluid restriction
- Risk for infection related to ICP monitoring system (fiberoptic or intraventricular catheter)

Other relevant nursing diagnoses are included in the earlier section on altered LOC.

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Brainstem herniation
- Diabetes insipidus
- SIADH

Planning and Goals

The goals for the patient include maintenance of a patent airway, normalization of respiration, adequate cerebral tissue perfusion through reduction in ICP, restoration of fluid balance, absence of infection, and absence of complications.

Nursing Interventions

Maintaining a Patent Airway

The patency of the airway is assessed. Secretions that are obstructing the airway must be suctioned with care, because transient elevations of ICP occur with suctioning (Hickey, 2014). Hypoxia caused by poor oxygenation leads to cerebral ischemia and edema. Coughing is discouraged because it increases ICP. The lung fields are auscultated at least every 8 hours to determine the presence of adventitious sounds or any areas of congestion. Elevating the head of the bed may aid in clearing secretions and improve venous drainage of the brain.

Achieving an Adequate Breathing Pattern

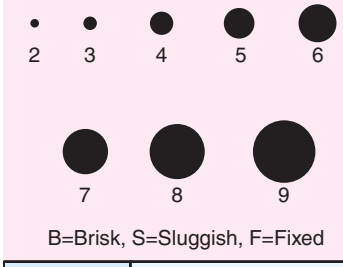
The patient must be monitored constantly for respiratory irregularities. Increased pressure on the frontal lobes or deep midline structures may result in Cheyne–Stokes respirations, whereas pressure in the midbrain can cause hyperventilation. If the lower portion of the brainstem (the pons and medulla) is involved, respirations become irregular and eventually cease.

Hyperventilation therapy is a controversial therapy in traumatic brain injury used in some centers to reduce ICP by causing cerebral vasoconstriction and a decrease in cerebral blood volume. The nurse collaborates with the respiratory therapist in monitoring the $PaCO_2$, which is usually maintained at less than 30 mm Hg. Patients undergoing hyperventilation therapy also benefit from multimodality monitoring to determine the overall effect of this therapy on brain perfusion (de Lima Oliveira et al., 2014).

A neurologic observation record (see Fig. 49-8) is maintained, and all observations are made in relation to the patient's baseline condition. Repeated assessments of the patient are made (sometimes minute by minute) so that improvement or deterioration may be noted immediately. If the patient's condition deteriorates, the primary provider is notified emergently and preparations are made for surgical intervention.

NURSING NEUROLOGIC CRITICAL CARE FLOWSHEET		ADDRESSOGRAPH											
	Date												
	Time												
	Initials												
Level of orientation (✓)	Person												
	Place												
	Date and time												
	No orientation												
Awakens to (✓)	Voice												
	Touch												
	Noxious stimuli												
	Painful stimuli												
	No response												
Best verbal response (✓)	Clear and appropriate												
	Clear and inappropriate												
	Difficulty speaking*												
	Perseveration												
	Aphasic expressive (non-fluent)												
	Aphasic receptive (fluent)												
	Sounds no speech												
	No verbal response												
	ETT/TRACH												
Best motor response (✓)	Moves all extremities purposefully												
	Withdraws and lifts to painful stimuli												
	Moves to painful stimuli												
	Decorticates (spinal reflex)												
	Decerebrates (spinal reflex)												
	No motor response												
Best motor strength upper extremities (✓)	No drifts (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Drift (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Can only lift forearm (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Trace movement of hand or arm (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Trace movement of fingers only (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	No motor response (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
Best strength lower extremities (✓)	Raises leg off bed (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Drags heel on bed and lifts knee (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Trace movement of foot or leg (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Trace movement of toes only (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	No response (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
Seizure activity (✓)	No seizure activity												
	With loss of consciousness*												
	Without loss of consciousness*												
Ataxia (✓)	Gross ataxia												
	Fine motor ataxia												
	Does not apply												
ICP monitoring	Ventriculostomy mL												
	ICP mm Hg												
	Not applicable												
*= **FURTHER DOCUMENTATION IS REQUIRED TO VALIDATE ASSESSMENT**													

Figure 49-8 • A neurologic assessment flowsheet. (*Continued*)



ADDRESSOGRAPH

Date													
Time													
Initials													
Incision +/–	Dry and intact												
	Drainage												
Pupils: refer to above gauge (✓) (+)=Present (–)=Absent	Size (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Regular (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Irregular* (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Reaction (R/L) (B) - (S) - (F)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Ptosis (R/L) (+) (–)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Gaze preference (R/L) (+)* (–)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
Meningeal signs (+)=Present (–)=Absent	Headache												
	Nuchal rigidity												
	Photophobia												
Visual fields (+)=Present (–)=Absent* NA=Not applicable	Right upper outer												
	Right lower outer												
	Left upper outer												
	Left lower outer												
Nystagmus (+)=Present (–)=Absent	Lateral (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	Vertical (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
Cranial nerves (+)=Present (–)=Absent	III, IV, VI, Extraocular movements												
	VII – Peripheral facial droop (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	XII – Tongue deviation (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	IX – Gag reflex												
	V, VII – Corneal reflex (R/L)	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L	R L
	X, IX – Cough reflex												
	Doll's eyes if appropriate												
Follows commands	Two step verbal command												
	One step verbal command												
	Unable to follow command												

*= **FURTHER DOCUMENTATION IS REQUIRED TO VALIDATE ASSESSMENT**

Initials	Signature	Title	Initials	Signature	Title

Figure 49-8 • (*Continued*) A neurologic assessment flowsheet.

TABLE 49-2 Increased Intracranial Pressure and Interventions

Factor	Physiology	Interventions	Rationale
Cerebral edema	Can be caused by contusion, tumor, or abscess; water intoxication (hypo-osmolality); alteration in the blood–brain barrier (protein leaks into the tissue, causing water to follow)	Administer osmotic diuretics as prescribed (monitor serum osmolality). Maintain head of bed elevation at 30 degrees. Maintain alignment of the head.	Promotes venous return Prevents impairment of venous return through the jugular veins
Hypoxia	A decrease in PaO_2 to <60 mm Hg causes cerebral vasodilation.	Maintain PaO_2 >60 mm Hg. Maintain oxygen therapy. Monitor arterial blood gas values. Suction when needed. Maintain a patent airway.	Prevents hypoxia and vasodilation
Hypercapnia (elevated $PaCO_2$)	Causes vasodilation	Maintain $PaCO_2$ (normally 35–45 mm Hg) by establishing ventilation.	Normalizing $PaCO_2$ minimizes vasodilation and thus reduces the cerebral blood volume.
Impaired venous return	Increases the cerebral blood volume	Maintain head alignment. Elevate head of bed 30 degrees.	Hyperextension, rotation, or hyperflexion of the neck causes decreased venous return.
Increase in intrathoracic or abdominal pressure	An increase in these pressures due to coughing, PEEP, or Valsalva maneuver causes a decrease in venous return.	Monitor arterial blood gas values, and keep PEEP as low as possible. Provide humidified oxygen. Administer stool softeners as prescribed.	To keep secretions loose and easy to suction or expectorate Soft bowel movements will prevent straining or Valsalva maneuver.

$PaCO_2$, partial pressure of arterial carbon dioxide; PaO_2, partial pressure of arterial oxygen; PEEP, positive end-expiratory pressure.

Adapted from American Association of Neuroscience Nurses. (2012). Care of the patient undergoing intracranial pressure monitoring/external ventricular drainage or lumbar drainage: AANN Clinical Practice Guideline Series. Glenview, IL: Author; Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Optimizing Cerebral Tissue Perfusion

In addition to ongoing nursing assessment, strategies are initiated to reduce factors contributing to the elevation of ICP (see Table 49-2).

Proper positioning helps reduce ICP. The patient's head is kept in a neutral (midline) position, maintained with the use of a cervical collar if necessary, to promote venous drainage. Elevation of the head is maintained at 30 to 45 degrees unless contraindicated. Extreme rotation of the neck and flexion of the neck are avoided, because compression or distortion of the jugular veins increases ICP. Extreme hip flexion is also avoided, because this position causes an increase in intra-abdominal and intrathoracic pressures, which can produce an increase in ICP. Relatively minor changes in position can significantly affect ICP. If monitoring reveals that turning the patient raises ICP, rotating beds, turning sheets, and holding the patient's head during turning may minimize the stimuli that increase ICP. Research suggests that patient response to position change is highly variable and requires close hemodynamic monitoring and individualized care (Mitchell, Kirkness, & Blissitt, 2015).

The Valsalva maneuver, which can be produced by straining at defecation or even moving in bed, raises ICP and is to be avoided. Stool softeners may be prescribed. If the patient is alert and able to eat, a diet high in fiber may be indicated. Abdominal distention, which increases intra-abdominal and intrathoracic pressure and ICP, should be noted. Enemas and cathartics are avoided if possible. When moving or being turned in bed, the patient can be instructed to exhale (which opens the glottis) to avoid the Valsalva maneuver.

Mechanical ventilation presents unique problems for the patient with increased ICP. Before suctioning, the patient should be preoxygenated and briefly hyperventilated using 100% oxygen on the ventilator. Suctioning should not last longer than 15 seconds. High levels of positive end-expiratory pressure (PEEP) must be utilized cautiously, because they may decrease venous return to the heart and decrease venous drainage from the brain through increased intrathoracic pressure (Nemer, Caldeira, Santos, et al., 2015).

Activities that increase ICP, as indicated by changes in waveforms, should be avoided if possible. Spacing of nursing interventions may prevent transient increases in ICP. During nursing interventions, the ICP should not increase above 25 mm Hg, and it should return to baseline levels within 5 minutes. Patients with increased ICP should not demonstrate a significant increase in pressure or change in the ICP waveform. Patients with the potential for a significant increase in ICP may need sedation before initiation of nursing activities (Bader, Littlejohns, & Olson, 2016).

Emotional stress and frequent arousal from sleep are avoided. A calm atmosphere is maintained. Environmental stimuli (e.g., noise, conversation) should be minimal.

Maintaining Negative Fluid Balance

The administration of osmotic and loop diuretics is part of the treatment protocol to reduce ICP. Corticosteroids may be used to reduce cerebral edema (except when it results from trauma), and fluids may be restricted. All of these treatment modalities promote dehydration.

Skin turgor, mucous membranes, urine output, and serum and urine osmolality are monitored to assess fluid status. If IV fluids are prescribed, the nurse ensures that they are given at a slow to moderate rate with an IV infusion pump, to prevent too-rapid administration and avoid overhydration. For the patient receiving mannitol, the nurse observes for the possible

development of heart failure and pulmonary edema. The intent of treatment is to promote a shift of fluid from the intracellular to the intravascular compartment and to control cerebral edema. However, this shift of fluid volume to the intravascular compartment may overwhelm the ability of the myocardium to increase workload sufficient to meet these demands, which may cause failure and pulmonary edema.

For patients undergoing dehydrating procedures, vital signs, including blood pressure, must be monitored to assess fluid volume status. An indwelling urinary catheter is inserted to permit assessment of renal function and fluid status. During the acute phase, urine output is monitored hourly. An output greater than 200 mL per hour for 2 consecutive hours may indicate the onset of diabetes insipidus (Hickey, 2014). These patients need careful oral hygiene, because mouth dryness occurs with dehydration. Frequently rinsing the mouth with nondrying solutions, lubricating the lips, and removing encrustations relieve dryness and promote comfort.

Preventing Infection

The risk of infection is greatest when ICP is monitored with an intraventricular catheter and increases with the duration of the monitoring. Most health care facilities have written protocols for managing these systems and maintaining their sterility; strict adherence to the protocols is essential.

Aseptic technique must be used when managing the system and changing the ventricular drainage bag. The drainage system is also checked for loose connections, because they can cause leakage and contamination of the CSF as well as inaccurate readings of ICP. The nurse observes the character of the CSF drainage and reports increasing cloudiness or blood. The patient is monitored for signs and symptoms of meningitis: fever, chills, nuchal (neck) rigidity, and increasing or persistent headache. See Chapter 52 for a discussion of meningitis.

Monitoring and Managing Potential Complications

The primary complication of increased ICP is brain herniation resulting in death (see Fig. 49-4). Nursing management focuses on detecting early signs of increasing ICP, because medical interventions are usually ineffective once later signs develop (Bader et al., 2016). Frequent neurologic assessments and documentation and analysis of trends will reveal the subtle changes that may indicate increasing ICP.

Detecting Indications of Increasing Intracranial Pressure. The nurse assesses for and immediately reports any signs or symptoms of increasing ICP (see Chart 49-1). The focus is on detecting early signs of increasing ICP.

Monitoring Intracranial Pressure. Because clinical assessment is not always a reliable guide in recognizing increased ICP, especially in patients who are comatose, monitoring of ICP and cerebral oxygenation is an essential part of management. ICP is monitored closely for continuous elevation or significant increase over baseline. The trend of ICP measurements over time is an important indication of the patient's underlying status. Vital signs are assessed when an increase in ICP is noted (Bader et al., 2016).

Careful attention to aseptic technique is needed when handling any part of the monitoring system. The insertion site is inspected for signs of infection. Temperature, pulse, and respirations are closely monitored for systemic signs of infection. All connections and stopcocks are checked for leaks, because even small leaks can distort pressure readings and lead to infection (AANN, 2012).

Chart 49-1

Detecting Increasing Intracranial Pressure (ICP)

Early Signs and Symptoms of Increasing ICP

- *Disorientation, restlessness, increased respiratory effort, purposeless movements, and mental confusion.* These are early clinical indications of increasing ICP because the brain cells responsible for cognition are extremely sensitive to decreased oxygenation.
- *Pupillary changes and impaired extraocular movements.* These occur as the increasing pressure displaces the brain against the oculomotor and optic nerves (cranial nerves II, III, IV, and VI), which arise from the midbrain and brainstem (see Chapter 48).
- *Weakness in one extremity or on one side of the body.* This occurs as increasing ICP compresses the pyramidal tracts.
- *Headache that is constant, increasing in intensity, and aggravated by movement or straining.* This occurs as increasing ICP causes pressure and stretching of venous and arterial vessels in the base of the brain.

Later Signs and Symptoms of Increasing ICP

- The level of consciousness continues to deteriorate until the patient is comatose (Glasgow Coma Scale score ≤8).
- The pulse rate and respiratory rate decrease or become erratic, and the blood pressure and temperature increase. The pulse pressure (the difference between the systolic and diastolic pressures) widens. The pulse fluctuates rapidly, varying from bradycardia to tachycardia.
- Altered respiratory patterns develop, including Cheyne–Stokes breathing (rhythmic waxing and waning of rate and depth of respirations alternating with brief periods of apnea) and ataxic breathing (irregular breathing with a random sequence of deep and shallow breaths).
- Projectile vomiting may occur with increased pressure on the reflex center in the medulla.
- Hemiplegia or decorticate or decerebrate posturing may develop as pressure on the brainstem increases; bilateral flaccidity occurs before death.
- Loss of brainstem reflexes, including pupillary, corneal, gag, and swallowing reflexes, is an ominous sign of approaching death.

Adapted from Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

When ICP is monitored with a fluid system, the transducer is calibrated at a particular reference point, usually 2.5 cm (1 inch) above the ear with the patient in the supine position; this point corresponds to the level of the foramen of Monro (see Fig. 49-9). CSF pressure readings depend on the patient's position. For subsequent pressure readings, the head should be in the same position relative to the transducer. Fiberoptic catheters are calibrated before insertion and do not require further referencing; they do not require the head of the bed to be at a specific position to obtain an accurate reading.

When technology is associated with patient management, the nurse must be certain that the technologic equipment is functioning properly. The most important concern must be the patient to whom equipment is attached. The patient and family must be informed about the technology and the goals of its use. The patient's response is monitored, and appropriate comfort measures are implemented to ensure that the patient's stress is minimized.

ICP measurement is only one parameter; repeated neurologic checks and clinical examinations remain important measures. Astute observation, comparison of findings with

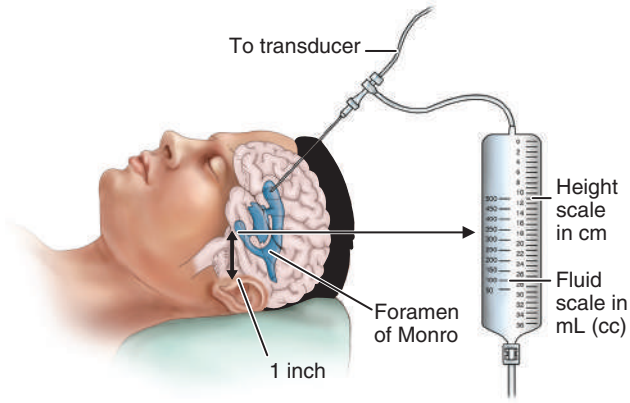


Figure 49-9 • Location of the foramen of Monro for calibration of the intracranial pressure monitoring system.

previous observations, and interventions can assist in preventing life-threatening ICP elevations.

Monitoring for Secondary Complications. The nurse also assesses for complications of increased ICP, including diabetes insipidus and SIADH (see Chapters 7 and 32). Urine output should be monitored closely. Diabetes insipidus requires fluid and electrolyte replacement, along with the administration of vasopressin, to replace and slow the urine output. Serum electrolyte levels are monitored for imbalances. SIADH requires fluid restriction and monitoring of serum electrolyte levels.

Evaluation

Expected patient outcomes may include:

1. Maintains patent airway
2. Attains optimal breathing pattern
   a. Breathes in a regular pattern
   b. Attains or maintains arterial blood gas values within acceptable range
3. Demonstrates optimal cerebral tissue perfusion
   a. Increasingly oriented to time, place, and person
   b. Follows verbal commands; answers questions correctly
4. Attains desired fluid balance
   a. Maintains fluid restriction
   b. Demonstrates serum and urine osmolality values within acceptable range
5. Has no signs or symptoms of infection
   a. Has no fever
   b. Shows no redness, swelling, or drainage at arterial, IV, and urinary catheter sites
   c. Has no redness, swelling, or purulent drainage from invasive intracranial monitoring device
6. Absence of complications
   a. Has ICP values that remain within normal limits
   b. Demonstrates urine output and serum electrolyte levels within acceptable limits

INTRACRANIAL SURGERY

A craniotomy involves opening the skull surgically to gain access to intracranial structures. This procedure is performed to remove a tumor, relieve elevated ICP, evacuate a blood clot, or control hemorrhage. The surgeon cuts the skull to create a bony flap, which can be repositioned after surgery and held in place by periosteal or wire sutures. One of two approaches through the skull is used: (1) above the tentorium (supratentorial craniotomy) into the supratentorial compartment, or (2) below the tentorium into the infratentorial (posterior fossa) compartment. A third approach, the transsphenoidal approach (through the mouth and nasal sinuses) is often used to gain access to the pituitary gland (Bader et al., 2016). Table 49-3 compares these three different surgical approaches.

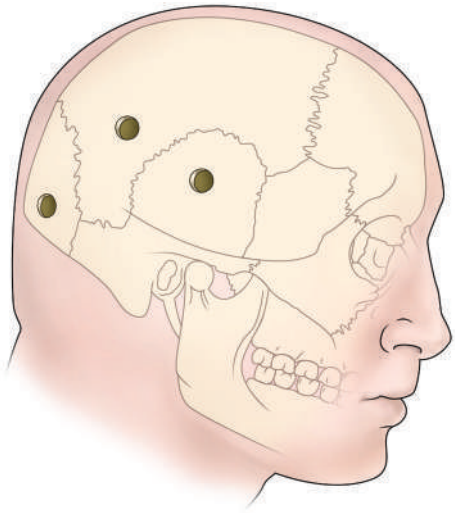


Figure 49-10 • Burr holes may be used in neurosurgical procedures to make a bone flap in the skull, to aspirate a brain abscess, or to evacuate a hematoma.

Alternatively, intracranial structures may be approached through burr holes (see Fig. 49-10), which are circular openings made in the skull by either a hand drill or an automatic craniotome (which has a self-controlled system to stop the drill when the bone is penetrated). Burr holes may be used to determine the presence of cerebral swelling and injury and the size and position of the ventricles. They are also a means of evacuating an intracranial hematoma or abscess and for making a bone flap in the skull that allows access to the ventricles for decompression, ventriculography, or shunting procedures. Other cranial procedures include craniectomy (excision of a portion of the skull) and cranioplasty (repair of a cranial defect using a plastic or metal plate).

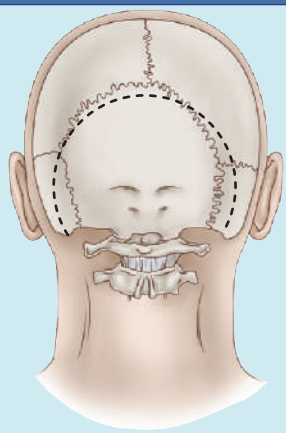
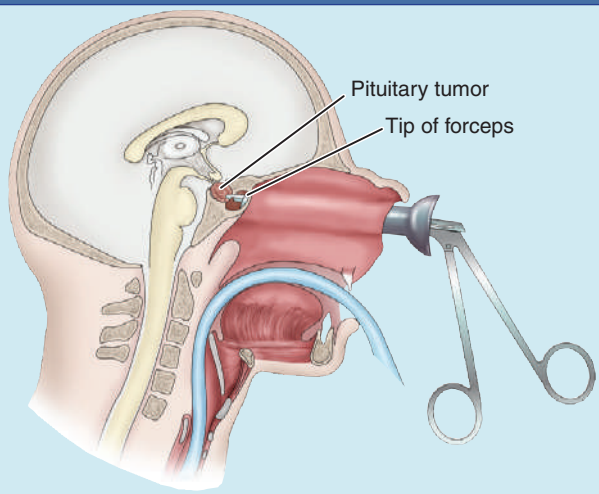
Supratentorial and Infratentorial Approaches

Preoperative Management

Medical Management

Preoperative diagnostic procedures may include a CT scan to demonstrate the lesion and show the degree of surrounding brain edema, the ventricular size, and the displacement. An MRI scan provides information similar to that of a CT scan with improved tissue contrast, resolution, and anatomic definition. Cerebral angiography may be used to study a tumor's blood supply or obtain information about vascular lesions. Transcranial Doppler flow studies are used to evaluate the blood flow within intracranial blood vessels.

TABLE 49-3 Comparison of Cranial Surgical Approaches

Supratentorial	Infratentorial	Transsphenoidal
		
Site of Surgery		
Above the tentorium	Below the tentorium, brainstem	Sella turcica and pituitary region
Incision Location		
Incision is made above the area to be operated on; usually located behind the hairline.	Incision is made at the nape of the neck, around the occipital lobe.	Incision is made beneath the upper lip to gain access into the nasal cavity.
Selected Nursing Interventions		
Maintain head of bed elevated at 30 degrees, with neck in neutral alignment.	Maintain neck in straight alignment. Avoid flexion of the neck to prevent possible tearing of the suture line.	Maintain nasal packing in place and reinforce as needed. Instruct patient to avoid blowing the nose. Provide oral care according to institutional procedure.
Position patient on either side or back. (Avoid positioning patient on operative side if a large tumor has been removed.)	Position the patient on either side. (Check surgeon's preference for positioning of patient.)	Keep head of bed elevated to promote venous drainage and drainage from the surgical site.

Most patients are prescribed an anticonvulsant medication such as phenytoin (Dilantin), levetiracetam (Keppra), or a phenytoin metabolite fosphenytoin sodium (Cerebyx) before surgery to reduce the risk of postoperative seizures (paroxysmal transient disturbance of the brain resulting from a discharge of abnormal electrical activity) (Karch, 2015). Before surgery, corticosteroids such as dexamethasone may be given to reduce cerebral edema if the patient has a brain tumor. Fluids may be restricted. A hyperosmotic agent (mannitol) and a diuretic agent such as furosemide (Lasix) may be administered IV immediately before and sometimes during surgery if the patient tends to retain fluid, as do many who have intracranial zdysfunction. Antibiotic agents may be given if there is a chance of cerebral contamination; diazepam (Valium) or lorazepam (Ativan) may be prescribed before surgery to allay anxiety.

Nursing Management

The preoperative assessment serves as a baseline against which postoperative status and recovery are compared (Bauman & McCourt, 2014). This assessment includes evaluating the LOC and responsiveness to stimuli and identifying any neurologic deficits, such as paralysis, visual dysfunction, alterations in personality or speech, and bladder and bowel disorders. Baseline distal and proximal motor strength in both upper and lower extremities is tested and recorded. See Chapter 48 for a discussion of the testing of motor function.

The patient's and family's understanding of and reactions to the anticipated surgical procedure and its possible sequelae are assessed, as is the availability of support systems for the patient and family. Adequate preparation for surgery, with attention to the patient's physical and emotional status, can reduce the risk of anxiety, fear, and postoperative complications. The patient is assessed for neurologic deficits and their potential impact after surgery. For motor deficits or weakness or paralysis of the arms or legs, trochanter rolls are applied to the extremities, and the feet are positioned against a footboard or the ankles are supported in a neutral position with orthotic boots. A patient who can ambulate is encouraged to do so. If the patient is aphasic, writing materials or picture and word cards showing the bedpan, glass of water, blanket, and other frequently used items may help improve communication.

Preparation of the patient and family includes providing education about what to expect during and after surgery. The patient should plan to shower and wash their hair prior to surgery using the preferred cleansing solution. Hair is removed with the use of clippers and the surgical site prepared immediately before surgery (usually in the operating room), and intravenous antibiotics are given 1 hour prior to the incision to decrease the chance of infection (AANN, 2016b).

An indwelling urinary catheter is inserted in the operating room to drain the bladder during the administration of diuretic agents and to permit monitoring of urinary output. The patient may have a central and an arterial line placed for fluid administration and monitoring of pressures after surgery. The large head dressing applied after surgery may impair hearing temporarily. Vision may be limited if the eyes are swollen shut. If a tracheostomy or endotracheal tube is in place, the patient will be unable to speak until the tube is removed, so an alternative method of communication must be established.

An altered cognitive state may make the patient unaware of the impending surgery. Even so, encouragement and attention to the patient's needs are necessary. Whatever the state of awareness of the patient, the family need reassurance and support, because they usually recognize the seriousness of brain surgery.

Postoperative Management

Postoperatively, an arterial line and a central venous pressure line may be in place to monitor and manage blood pressure and central venous pressure. The patient may be intubated and may receive supplemental oxygen therapy. Ongoing postoperative management is aimed at detecting and reducing cerebral edema, relieving pain and preventing seizures, and monitoring ICP and neurologic status.

Reducing Cerebral Edema

Medications to reduce cerebral edema include mannitol, which increases serum osmolality and draws free water from areas of the brain (with an intact blood–brain barrier). The fluid is then excreted by osmotic diuresis. Dexamethasone may be administered IV every 6 hours for 24 to 72 hours; the route is changed to oral as soon as possible, and the dosage is tapered over 5 to 7 days (Karch, 2015).

Relieving Pain and Preventing Seizures

Acetaminophen is usually prescribed for temperatures exceeding 37.5°C (99.6°F) and for mild pain. The patient usually has a headache after a craniotomy as a result of stretching and irritation of nerves in the scalp during surgery. Codeine, administered IV or orally, is often sufficient to relieve headache. Morphine sulfate may also be used in the management of postoperative pain in patients who have undergone a craniotomy with the goal of a patient reporting acceptable pain level (AANN, 2016b).

Anticonvulsant medication (phenytoin, levetiracetam) is often prescribed prophylactically for patients who have undergone supratentorial craniotomy because of the high risk of seizures after these procedures (Hickey, 2014). Serum levels are monitored to check that the medication levels are within the therapeutic range.

Monitoring Intracranial Pressure

A patient undergoing intracranial surgery may have an ICP or cerebral oxygenation monitor inserted during surgery. Strict adherence to written protocols for managing these systems is essential, as discussed earlier, for preventing infection and managing ICP. The system is removed after the ICP or cerebral oxygenation is normal and stable. The neurosurgeon must be notified immediately if the system is not functioning.

NURSING PROCESS

The Patient who has Undergone Intracranial Surgery

Assessment

After surgery, the frequency of postoperative monitoring is based on the patient's clinical status. Assessing respiratory function is essential, because even a small degree of hypoxia can increase cerebral ischemia. The respiratory rate and pattern are monitored, and arterial blood gas values are assessed frequently. Fluctuations in vital signs are carefully monitored and documented, because they may indicate increased ICP. The patient's temperature is measured to assess for hyperthermia secondary to infection or damage to the hypothalamus. Neurologic checks are made frequently to detect increased ICP resulting from cerebral edema or bleeding. A change in LOC or response to stimuli may be the first sign of increasing ICP.

The surgical dressing is inspected for evidence of bleeding and CSF drainage. The incision is monitored for redness, tenderness, bulging, separation, or foul odor. Sodium retention may occur in the immediate postoperative period. Serum and urine electrolytes, BUN, blood glucose, weight, and clinical status are monitored. Intake and output are measured in view of losses associated with fever, respiration, and CSF drainage. The nurse must be alert to the development of complications; all assessments are carried out with these problems in mind. Seizures are a potential complication, and any seizure activity is carefully recorded and reported. Restlessness may occur as the patient becomes more responsive, or restlessness may be caused by pain, confusion, hypoxia, or other stimuli.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Risk for ineffective cerebral tissue perfusion related to cerebral edema
- Risk for imbalanced body temperature related to damage to the hypothalamus, dehydration, and infection
- Potential for impaired gas exchange related to hypoventilation, aspiration, and immobility
- Ineffective coping related to sensory perception changes due to periorbital edema, head dressing, endotracheal tube, and effects of ICP
- Disturbed body image related to change in appearance or physical disabilities

Other nursing diagnoses may include impaired communication (aphasia) related to insult to brain tissue and high risk for impaired skin integrity related to immobility, pressure, and incontinence; impaired physical mobility related to a neurologic deficit secondary to the neurosurgical procedure or to the underlying disorder may also occur.

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Increased ICP
- Bleeding and hypovolemic shock
- Fluid and electrolyte disturbances
- Infection
- CSF leak
- Seizures

Planning and Goals

The major goals for the patient include maintaining or restoring neurologic homeostasis to improve cerebral tissue perfusion, adequate thermoregulation, normal ventilation and gas exchange, ability to cope with sensory deprivation, adaptation to changes in body image, and absence of complications.

Nursing Interventions

Maintaining Cerebral Tissue Perfusion

Attention to the patient's respiratory status is essential, because even slight decreases in the oxygen level (hypoxia) or slight increases in the carbon dioxide level (hypercarbia) can affect cerebral perfusion, the clinical course, and the patient's outcome. The endotracheal tube is left in place until the patient shows signs of awakening and has adequate spontaneous ventilation, as evaluated clinically and by arterial blood gas analysis. Secondary brain damage can result from impaired cerebral oxygenation.

Some degree of cerebral edema occurs after brain surgery; it tends to peak 24 to 36 hours after surgery, potentially producing decreased responsiveness on the second postoperative day. The control of cerebral edema was discussed earlier. Nursing strategies used to control factors that may raise ICP were presented in the previous Nursing Process section on increased ICP. Intraventricular drainage is carefully monitored, using strict asepsis when any part of the system is handled.

Vital signs and neurologic status (LOC and responsiveness, pupillary and motor responses) are assessed every 15 to 60 minutes. Extreme head rotation is avoided, because this raises ICP. After supratentorial surgery, the patient is placed on their back or side (on the unoperated side if a large lesion was removed) with one pillow under the head. The head of the bed may be elevated 30 degrees, depending on the level of the ICP and the neurosurgeon's preference. After posterior fossa (infratentorial) surgery, the patient is kept flat on one side (off the back) with the head on a small, firm pillow. The patient may be turned on either side, keeping the neck in a neutral position. When the patient is being turned, the body should be turned as a unit to prevent placing strain on the incision and possibly tearing the sutures. The head of the bed may be elevated slowly as tolerated by the patient.

The patient's position is changed every 2 hours, and skin care is given frequently. During position changes, care is taken to prevent disruption of the ICP monitoring system. A turning sheet or lift sling placed under the patient's head to midthigh makes it easier to move and turn the patient safely.

Regulating Temperature

Moderate temperature elevation can be expected after intracranial surgery because of the reaction to blood at the operative site or in the subarachnoid space. Injury to the hypothalamic centers that regulate body temperature can occur during surgery. Fever is treated vigorously to combat the effect of an elevated temperature on brain metabolism and function.

Nursing interventions include monitoring the patient's temperature and using the following measures to reduce body temperature: removing blankets, placing ice packs, and administering prescribed antipyretics to reduce fever (Rockett, Thompson, & Blissitt, 2015).

Conversely, hypothermia may be seen after lengthy neurosurgical procedures. Therefore, frequent measurements of rectal temperatures are necessary. Rewarming should occur slowly to prevent shivering, which increases cellular oxygen demands.

Improving Gas Exchange

The patient undergoing neurosurgery is at risk for impaired gas exchange and pulmonary infections due to immobility, immunosuppression, decreased LOC, and fluid restriction. Immobility compromises the respiratory system by causing pooling and stasis of secretions in dependent areas and the development of atelectasis. The patient whose fluid intake is restricted may be more vulnerable to atelectasis as a result of inability to expectorate thickened secretions. Pneumonia can develop due to aspiration and restricted mobility.

Repositioning the patient every 2 hours helps to mobilize pulmonary secretions and prevent stasis. After the patient regains consciousness, additional measures to expand collapsed alveoli can be instituted, such as yawning, sighing, deep breathing, incentive spirometry, and coughing (unless contraindicated). If necessary, the oropharynx and trachea are suctioned to remove secretions that cannot be raised by coughing; however, coughing and suctioning increase ICP. Therefore, suctioning should be used cautiously. Increasing the humidity in the oxygen delivery system may help to loosen secretions. The nurse and the respiratory therapist work together to monitor the effects of chest physiotherapy.

Coping with Sensory Deprivation

Periorbital edema is a common consequence of intracranial surgery, because fluid drains into the dependent periorbital areas when the patient has been positioned in a prone position during surgery. A hematoma may form under the scalp and spread down to the orbit, producing an area of ecchymosis (black eye).

Before surgery, the patient and family should be informed that one or both eyes may be edematous temporarily after surgery. After surgery, elevating the head of the bed (if not contraindicated) and applying cold compresses over the eyes will help reduce the edema. The surgeon is notified if periorbital edema increases significantly, because this may indicate that a postoperative clot is developing or that there is increasing ICP and poor venous drainage. Health care personnel should announce their presence when entering the room to avoid startling the patient whose vision is impaired due to periorbital edema or neurologic deficits.

Additional factors that can affect sensation include a bulky head dressing, the presence of an endotracheal tube, and effects of increased ICP. The first postoperative dressing change is usually performed by the neurosurgeon. In the absence of bleeding or a CSF leak, every effort is made to minimize the size of the head dressing. If the patient requires an endotracheal tube for mechanical ventilation, every effort is made to extubate the patient as soon as clinical signs indicate it is possible. The patient is monitored closely for the effects of elevated ICP.

Enhancing Self-Image

The patient is encouraged to verbalize feelings and frustrations about any change in appearance. Nursing support is based on the patient's reactions and feelings. Factual information may need to be provided if the patient has misconceptions about puffiness about the face, periorbital bruising, and hair loss. Attention to grooming, the use of the patient's own clothing, and covering the head with a turban (and later a wig until hair growth occurs) are encouraged. Social interaction with close friends, family, and hospital personnel may increase the patient's sense of self-worth.

The family and social support system can be of assistance while the patient recovers from surgery.

Monitoring and Managing Potential Complications

The nurse must be vigilant for complications that may develop within hours of surgery and require close collaboration with the neurosurgeon. These include increased ICP, bleeding and hypovolemic shock, altered fluid and electrolyte balance (e.g., water intoxication and diabetes insipidus), infection, identification of a CSF leak, and seizures.

Monitoring for Increased Intracranial Pressure and Bleeding. Increased ICP and bleeding are life threatening to the patient who has undergone intracranial surgery. The following points must be kept in mind when caring for any patient who has undergone such surgery:

- An increase in blood pressure and decrease in pulse with respiratory failure may indicate increased ICP.
- An accumulation of blood under the bone flap (extradural, subdural, or intracerebral hematoma) may pose a threat to life. A clot must be suspected in any patient who does not awaken as expected or whose condition deteriorates. An intracranial hematoma is suspected if the patient has any new postoperative neurologic deficits (especially a dilated pupil on the operative side). In these circumstances, the patient is returned to the operating room immediately for evacuation of the clot, if indicated.
- Cerebral edema, infarction, metabolic disturbances, and hydrocephalus are conditions that may mimic the clinical manifestations of a clot.

The patient is monitored closely for indicators of complications, and early signs and trends in clinical status are reported to the surgeon. Treatments are initiated promptly, and the nurse assists in evaluating the patient's response to treatment. The nurse also provides support to the patient and family.

Nursing Alert: If signs and symptoms of increased ICP occur, efforts to decrease the ICP are initiated: alignment of the head in a neutral position without flexion to promote venous drainage, elevation of the head of the bed to 30 degrees (when prescribed), administration of mannitol (an osmotic diuretic), and possible administration of pharmacologic paralyzing agents.

Managing Fluid and Electrolyte Disturbances. Fluid and electrolyte imbalances may occur because of the patient's underlying condition and its management or as complications of surgery. These disturbances can contribute to the development of cerebral edema.

The postoperative fluid regimen depends on the type of neurosurgical procedure and is determined on an individual basis. The volume and composition of fluids are adjusted based on daily serum electrolyte values, along with fluid intake and output. Fluids may have to be restricted in patients with cerebral edema.

Oral fluids are usually resumed after the first 24 hours. The presence of gag and swallowing reflexes must be checked before initiation of oral fluids. Some patients with posterior fossa tumors have impaired swallowing, so fluids may need to be given by alternative routes. The patient should be observed for signs and symptoms of nausea and vomiting as the diet is progressed (AANN, 2016b).

Patients undergoing surgery for brain tumors often receive large doses of corticosteroids and are at risk for hyperglycemia. Serum glucose levels are measured every 4 to 6 hours, and sliding scale insulin is prescribed as needed. These patients are prone to stress ulcers, so histamine-2 receptor antagonists (H_2 blockers) are prescribed to suppress the secretion of gastric acid. Patients also are monitored for bleeding and assessed for gastric pain.

If the surgical site is near to (or causes edema to) the pituitary gland and hypothalamus, the patient may develop symptoms of diabetes insipidus, which is characterized by excessive urinary output, elevated serum osmolality, decreased urine osmolality, hypernatremia, and a low urine-specific gravity. The urine-specific gravity is measured hourly, and fluid intake and output are monitored. Fluid replacement must compensate for urine output, and serum potassium levels must be monitored.

SIADH, which results in water retention with hyponatremia and serum hypo-osmolality, occurs in a wide variety of CNS disorders (e.g., brain tumor, head trauma) causing fluid disturbances. Nursing management includes careful intake and output measurements, specific gravity determinations of urine, and monitoring of serum and urine electrolyte levels while following directives for fluid restriction. SIADH is usually self-limited.

Preventing Infection. The patient undergoing neurosurgery is at risk for infection related to the neurosurgical procedure (brain exposure, bone exposure, wound hematomas) and the presence of IV and arterial lines for fluid administration and monitoring. Risk for infection is increased in patients who undergo lengthy intracranial operations and in those who have external ventricular drains in place.

The dressing is often stained with blood in the immediate postoperative period. Because blood is an excellent culture medium for bacteria, the dressing is reinforced with sterile pads so that contamination and infection are avoided. A heavily stained or displaced dressing should be reported immediately. A drain is sometimes placed in the craniotomy incision to facilitate drainage.

After suboccipital surgical procedures, CSF may leak through the incision. This complication is dangerous because of the possibility of meningitis. After a craniotomy, the patient is instructed to avoid coughing, sneezing, or nose blowing, which can cause CSF leakage by creating pressure on the operative site.

Nursing Alert: Any sudden discharge of fluid from a cranial incision is reported at once, because a large leak requires surgical repair. Attention should be paid to the patient who complains of a salty taste or "postnasal drip," because this can be caused by CSF trickling down the throat.

Aseptic technique is used when handling dressings, drainage systems, and IV and arterial lines. The patient is monitored carefully for signs and symptoms of infection, and cultures are obtained if infection is suspected. Appropriate antibiotic agents are given as prescribed. Other causes of infection in the patient undergoing intracranial surgery, such as pneumonia and urinary tract infections, are similar to those in other patients postoperatively.

Monitoring for Seizure Activity. Seizures may occur as complications after any intracranial neurosurgical procedure. Preventing seizures is essential to avoid further cerebral edema. Administering the prescribed anticonvulsant medication before and after surgery may prevent the development of seizures in subsequent months and years. Status epilepticus (prolonged seizures without recovery of consciousness in the intervals between seizures) may occur after craniotomy and also may be related to the development of complications

(hematoma, ischemia). The management of status epilepticus is described later in this chapter.

Monitoring and Managing Other Complications. Other complications may occur during the first 2 weeks or later and may compromise the patient's recovery. The most important of these are VTE (DVT, PE), pulmonary and urinary tract infection, and pressure ulcers. Most of these complications may be avoided with frequent changes of position, adequate suctioning of secretions, thrombosis prophylaxis, early removal of indwelling urinary catheter, early ambulation, and skin care.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. The recovery at home of a patient who has had neurosurgery depends on the extent of the surgical procedure and its success. The patient's strengths as well as limitations are assessed and explained to the family, along with the family's part in promoting recovery. Because administration of anticonvulsant medication is a priority, the patient and family are educated to use a check-off system, pill boxes, and alarms to ensure that the medication is taken as prescribed.

The patient and family are educated about what to expect after intracranial surgery (see Chart 49-2). Dietary restrictions usually are not required unless another health problem necessitates a special diet. Although showering or tub bathing is permitted, the scalp should be kept dry until all sutures have been removed. A clean scarf or cap may be worn until a wig or hairpiece is purchased. If skull bone has been removed, a protective helmet may be prescribed. The patient may require rehabilitation, depending on the postoperative level of function. The patient may require physical therapy for residual weakness and mobility issues. An occupational therapist is consulted to assist with self-care issues. If the patient has aphasia, speech therapy may be necessary.

Continuing and Transitional Care. The patient is discharged from the hospital as soon as possible. Patients with severe motor deficits require extensive physical therapy and rehabilitation. Those with postoperative cognitive and speech impairments require psychological evaluation, speech therapy, and rehabilitation. The nurse collaborates with the physician and other health care professionals during hospitalization and home or transitional care to achieve as complete a rehabilitation as possible and to assist the patient in living with residual disability.

If tumor, injury, or disease makes the prognosis poor, care is directed toward making the patient as comfortable as possible. With return of the tumor or cerebral compression, the patient becomes less alert and aware. Other possible consequences include paralysis, blindness, and seizures. The home care nurse, hospice nurse, and social worker collaborate with the family to plan for additional services or placement of the patient in an extended care facility (see the Cerebral Metastases section in Chapter 53). The patient and family are encouraged to discuss end-of-life preferences for care; the patient's end-of-life preferences must be respected (see Chapter 59). The nurse involved in home and continuing care of patients after cranial surgery also should remind patients and family members of the need for health promotion activities and recommended health screening.

Evaluation

Expected patient outcomes may include:

1. Achieves optimal cerebral tissue perfusion
   a. Opens eyes on request; uses recognizable words, progressing to normal speech
   b. Obeys commands with appropriate motor responses
2. Maintains normal body temperature
   a. Registers normal body temperature
3. Has normal gas exchange
   a. Has arterial blood gas values within normal ranges
   b. Breathes easily; lung sounds clear without adventitious sounds
   c. Takes deep breaths and changes position as directed
4. Copes with sensory deprivation
5. Demonstrates improving self-concept
   a. Pays attention to grooming
   b. Visits and interacts with others
6. Exhibits absence of complications
   a. Exhibits ICP within normal range
   b. Has minimal bleeding at surgical site; surgical incision healing without evidence of infection
   c. Shows fluid balance and electrolyte levels within desired ranges
   d. Exhibits no evidence of seizures

Chart 49-2 HOME CARE CHECKLIST

Discharge after Intracranial Surgery

At the completion of education, the patient and/or caregiver will be able to:

- Name the procedure that was performed, any complications that occurred, and identify any permanent changes in anatomic structure or function as well as changes in ADLs, IADLs, roles, relationships, and spirituality.
- Identify interventions and strategies (e.g., durable medical equipment, adaptive equipment) used in recovery period.
- Describe ongoing postoperative therapeutic regimen, including diet and activities to perform (e.g., walking and breathing exercises) and to limit or avoid (e.g., lifting weights, driving a car, contact sports).
- State the name, dose, side effects, frequency, and schedule for all medications.
- State how to obtain medical supplies and carry out dressing changes, wound care, and other prescribed regimens.
- Identify durable medical equipment needs, proper usage, and maintenance necessary for safe utilization.
- Describe signs and symptoms of complications.
- State time and date of follow-up appointments.
- Relate how to reach primary provider with questions or complications.
- Identify community resources for peer and caregiver/family support:
  - Identify sources of support (e.g., friends, relatives, faith community).
  - Identify phone numbers, meeting locations/times of community resources for patients and their caregivers/families.
- Identify the need for health promotion (e.g., weight reduction, smoking cessation, stress management), disease prevention and screening activities.

ADL, activities of daily living; IADL, independent activities of daily living.

Transsphenoidal Approach

Tumors within the sella turcica and small adenomas of the pituitary can be removed through a transsphenoidal approach (see Table 49-3). Although an otorhinolaryngologist may make the initial opening, the neurosurgeon completes the opening into the sphenoidal sinus and exposes the floor of the sella. Microsurgical techniques provide improved illumination, magnification, and visualization so that nearby vital structures can be avoided.

The transsphenoidal approach offers direct access to the sella turcica with minimal risk of trauma and hemorrhage (Bader et al., 2016). It avoids many of the risks of craniotomy, and the postoperative discomfort is similar to that of other transnasal surgical procedures. It may also be used for pituitary ablation (destruction) in patients with metastatic breast or prostatic cancer.

Complications

Manipulation of the posterior pituitary gland during surgery may produce transient diabetes insipidus of several days' duration (Hickey, 2014). It is treated with vasopressin but occasionally persists. Other complications include CSF leakage, visual disturbances, postoperative meningitis, pneumocephalus (air in the intracranial cavity), and SIADH (see Chapter 32).

Preoperative Management

Medical Management

The preoperative evaluation includes a series of endocrine tests, rhinologic evaluation (to assess the status of the sinuses and nasal cavity), and neuroradiologic studies. Funduscopic examination and visual field determinations are performed, because the most serious effect of pituitary tumor is localized pressure on the optic nerve or chiasm. In addition, the nasopharyngeal secretions are cultured, because a sinus infection is a contraindication to an intracranial procedure using this approach. Corticosteroids may be given before and after surgery, because the surgery involves removal of the pituitary, which is the source of adrenocorticotropic hormone (ACTH). Antibiotic agents may or may not be given prophylactically.

Nursing Management

The patient is educated in deep breathing techniques before surgery. In addition, the patient is instructed that after the surgery, they will need to avoid vigorous coughing, blowing the nose, sucking through a straw, or sneezing, because these actions may place increased pressure at the surgical site and cause a CSF leak (Hickey, 2014).

Postoperative Management

Medical Management

Because the procedure disrupts the oral and nasal mucous membranes, management focuses on preventing infection and promoting healing. Medications include antimicrobial agents (which are continued until the nasal packing inserted at the time of surgery is removed), corticosteroids, analgesic agents for discomfort, and agents for the control of diabetes insipidus, if necessary (Hickey, 2014).

Nursing Management

Vital signs are measured to monitor hemodynamic, cardiac, and ventilatory status. Because of the anatomic proximity of the pituitary gland to the optic chiasm, visual acuity and visual fields are assessed at regular intervals. One method is to ask the patient to count the number of fingers held up by the nurse. Evidence of decreasing visual acuity suggests an expanding hematoma.

The head of the bed is raised to decrease pressure on the sella turcica and to promote normal drainage. The patient is cautioned against blowing the nose or engaging in any activity that raises ICP, such as bending over or straining during urination or defecation.

Intake and output are measured as a guide to fluid and electrolyte replacement and to assess for diabetes insipidus. The urine-specific gravity is measured after each voiding. Daily weight is monitored. Fluids are usually given after nausea ceases, and the patient then progresses to a regular diet.

The nasal packing inserted during surgery is checked frequently for blood or CSF drainage. The major discomfort is related to the nasal packing and to mouth dryness and thirst caused by mouth breathing. Oral care is provided every 4 hours or more frequently. Usually, the teeth are not brushed until the incision above the teeth has healed. Warm saline mouth rinses and the use of a cool mist vaporizer are helpful. Petrolatum is soothing when applied to the lips. A room humidifier assists in keeping the mucous membranes moist. The packing is removed in 3 to 4 days, and only then can the area around the nares be cleaned with the prescribed solution to remove crusted blood and moisten the mucous membranes (Hickey, 2014).

Home care considerations include advising the patient to use a room humidifier to keep the mucous membranes moist and to soothe irritation. The head of the bed is elevated at 30 degrees for at least 2 weeks after surgery. The patient is cautioned against blowing the nose or sneezing for at least 1 month (Hickey, 2014).

SEIZURE DISORDERS

Seizures are episodes of abnormal motor, sensory, autonomic, or psychic activity (or a combination of these) that result from sudden excessive discharge from cerebral neurons (Hickey, 2014). A localized area or all of the brain may be involved. The International League Against Epilepsy (ILAE) has defined epilepsy as at least two unprovoked seizures occurring more than 24 hours apart (Fisher, Acevedo, Arzimanoglou, et al., 2014). The ILAE differentiates between three main seizure types: focal, generalized, and unknown seizures (see Chart 49-3). Generalized seizures occur in and rapidly engage bilaterally distributed networks. Focal seizures are thought to originate within one hemisphere in the brain. The unknown type includes epileptic spasms. Unclassified seizures are so termed because of incomplete data but are not considered a classification (Fisher et al., 2014) Seizures may also be characterized as "provoked," or related to acute, reversible conditions such as structural, metabolic, immune, infectious or unknown etiologies (Scheffer, French, Hirsch, et al., 2016).

Pathophysiology

The underlying cause is an electrical disturbance (dysrhythmia) in the nerve cells in one section of the brain; these cells emit abnormal, recurring, uncontrolled electrical discharges. The characteristic seizure is a manifestation of this excessive neuronal discharge. Associated loss of consciousness, excess movement or loss of muscle tone or movement, and disturbances of behavior, mood, sensation, and perception may also occur (Fig. 49-11).

Chart 49-3

Classification of Seizures: 2016 Basic Scheme

Focal

- Motor
- Nonmotor
- Awareness
  - Aware
  - Impaired awareness
  - Unknown awareness

Generalized

- Motor
- Absence

Unknown

- Motor
- Non-motor
- Awareness
  - Aware
  - Impaired awareness
  - Unknown awareness
- Unclassified

Adapted from Fisher, R., Cross, H., French, J., et al. (2016). Operational classification of seizure types by the International League Against Epilepsy (ILAE). Retrieved on 9/29/2016 at: www.ilae.org/visitors/centre/documents/ClassificationSeizureILAE-2016.pdf

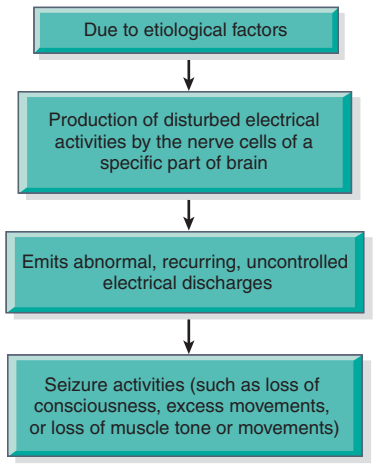


Figure 49-11 • Pathophysiology of seizure disorders.

The specific causes of seizures are varied and can be categorized as genetic, due to a structural or metabolic condition, or the cause may be yet unknown etiologies (Scheffer et al., 2016).
Causes of seizures include:

- Cerebrovascular disease
- Hypoxemia of any cause, including vascular insufficiency
- Fever (childhood)
- Head injury
- Hypertension
- CNS infections
- Metabolic and toxic conditions (e.g., kidney injury, hyponatremia, hypocalcemia, hypoglycemia, pesticide exposure)
- Brain tumor
- Drug and alcohol withdrawal
- Allergies

Clinical Manifestations

Depending on the location of the discharging neurons, seizures may range from a simple staring episode (generalized absence seizure) to prolonged convulsive movements with loss of consciousness.

The initial pattern of the seizures indicates the region of the brain in which the seizure originates (see Chart 49-3). Only a finger or hand may shake, or the mouth may jerk uncontrollably. The person may talk unintelligibly; may be dizzy; and may experience unusual or unpleasant sights, sounds, odors, or tastes, but without loss of consciousness (Hickey, 2014).

Generalized seizures often involve both hemispheres of the brain, causing both sides of the body to react. Intense rigidity of the entire body may occur, followed by alternating muscle relaxation and contraction (generalized tonic–clonic contraction). The simultaneous contractions of the diaphragm and chest muscles may produce a characteristic epileptic cry. The tongue is often chewed, and the patient is incontinent of urine and feces. After 1 or 2 minutes, the convulsive movements begin to subside; the patient relaxes and lies in deep coma, breathing noisily. The respirations at this point are chiefly abdominal. In the postictal state (after the seizure), the patient is often confused and hard to arouse and may sleep for hours. Many patients report headache, sore muscles, fatigue, and depression (AANN, 2016a). Other generalized seizures may be absence types of seizures (Fisher, Cross, French et al., 2016).

Focal seizures are subdivided into events characterized by both motor and non-motor symptoms. There may be an impairment of consciousness or awareness or other dyscognitive features, localization, and progression of symptoms (Fisher et al., 2016).

Assessment and Diagnostic Findings

The diagnostic assessment is aimed at determining the type of seizures, their frequency and severity, and the factors that precipitate them. A developmental history is taken, including events of pregnancy and childbirth, to seek evidence of pre-existing injury. The patient is also questioned about illnesses or head injuries that may have affected the brain. In addition to physical and neurologic evaluations, diagnostic examinations include biochemical, hematologic, and serologic studies. MRI is used to detect structural lesions such as focal abnormalities, cerebrovascular abnormalities, and cerebral degenerative changes (AANN, 2016a).

The EEG furnishes diagnostic evidence for a substantial proportion of patients with epilepsy and assists in classifying the type of seizure. Abnormalities in the EEG usually continue between seizures or, if not apparent, may be elicited by hyperventilation or during sleep (AANN, 2016a). Microelectrodes (depth electrodes) can be inserted deep in the brain to probe the action of single brain cells. Some people with clinical seizures have normal EEGs, whereas others who have never had seizures have abnormal EEGs. Telemetry and computerized equipment are used to monitor electrical brain activity while the patient pursues their normal activities and to store the readings on computer tapes for analysis. Video recording of seizures taken simultaneously with EEG telemetry is useful in determining the type of seizure as well as its duration and magnitude (Updyke & Duryea, 2013).

SPECT is an additional tool that is sometimes used in the diagnostic workup. It is useful for identifying the epileptogenic zone so that the area in the brain giving rise to seizures can be removed surgically (AANN, 2016a).

Nursing Management

During a Seizure

A major responsibility of the nurse is to observe and record the sequence of signs. The nature of the seizure usually indicates the type of treatment required (AANN, 2016a). Before and during a seizure, the patient is assessed and the following items are documented:

- Circumstances before the seizure (visual, auditory, or olfactory stimuli; tactile stimuli; emotional or psychological disturbances; sleep; hyperventilation)
- Occurrence of an aura (a premonitory or warning sensation, which can be visual, auditory, or olfactory)
- First thing the patient does in the seizure—where the movements or the stiffness begins, conjugate gaze position, and the position of the head at the beginning of the seizure. This information gives clues to the location of the seizure origin in the brain. (In recording, it is important to state whether the beginning of the seizure was observed.)
- Type of movements in the part of the body involved
- Areas of the body involved (turn back bedding to expose patient)
- Size of both pupils and whether the eyes are open
- Whether the eyes or head are turned to one side
- Presence or absence of automatisms (involuntary motor activity, such as lip smacking or repeated swallowing)
- Incontinence of urine or stool
- Duration of each phase of the seizure
- Unconsciousness, if present, and its duration
- Any obvious paralysis or weakness of arms or legs after the seizure
- Inability to speak after the seizure
- Movements at the end of the seizure
- Whether or not the patient sleeps afterward
- Cognitive status (confused or not confused) after the seizure

In addition to providing data about the seizure, nursing care is directed at preventing injury and supporting the patient, not only physically but also psychologically. Consequences such as anxiety, embarrassment, fatigue, and depression can be devastating to the patient.

After a Seizure

After a patient has a seizure, the nurse's role is to document the events leading to and occurring during and after the seizure and to prevent complications (e.g., aspiration, injury). The patient is at risk for hypoxia, vomiting, and pulmonary aspiration. To prevent complications, the patient is placed in the side-lying position to facilitate drainage of oral secretions, and suctioning is performed, if needed, to maintain a patent airway and prevent aspiration (see Chart 49-4). Seizure precautions are maintained, including having available functioning suction equipment with a suction catheter and oral airway. The bed is placed in a low position with two to three side rails up and padded, if necessary, to prevent injury to the patient. The patient may be drowsy and may wish to sleep after the seizure; they may not remember events leading up to the seizure and for a short time thereafter.

The Epilepsies

Epilepsy is a group of syndromes characterized by unprovoked, recurring seizures (AANN, 2016a). Epileptic syndromes are classified by specific patterns of clinical features, including age at onset, family history, and seizure type. The epilepsies include electroclinical syndromes (a complex of clinical features, signs, and symptoms) and other epilepsies (Institute of Medicine [IOM], 2012). Epilepsy can be primary (idiopathic) or secondary (when the cause is known and the epilepsy is a symptom of another underlying condition, such as a brain tumor).

Epilepsy affects an estimated 3% of people during their lifetime, and most forms of epilepsy occur in children and older adults (England, Liverman, Schultz, et al., 2012). It is estimated that around 70 million people live with epilepsy globally and the prevalence rate is 5–9/1,000 population (Sander, 2004; Amudhan et al.,2015;). In India, more than 12 million people are suffering with epilepsy, which contributes to nearly one-sixth of the global burden (Amudhan et al., 2015). The prevalence rate of epilepsy in South East Asia ranges from 2–10/1,000 population and more than half of the total disability-adjusted life years (DALYs) due to epilepsy in India.

The improved treatment for cerebrovascular disorders, head injuries, brain tumors, meningitis, and encephalitis has increased the number of patients at risk for seizures after recovery from these conditions. In addition, advances in EEG have aided in the diagnosis of epilepsy. The general public has been educated about epilepsy, which has reduced the stigma associated with it; as a result, more people are willing to acknowledge that they have epilepsy.

Although some evidence suggests that susceptibility to some types of epilepsy may be inherited, the cause of seizures in many people is idiopathic (unknown). Epilepsy can follow birth trauma, asphyxia neonatorum, head injuries, some infectious diseases (bacterial, viral, parasitic), toxicity (carbon monoxide and lead poisoning), circulatory problems, fever, metabolic and nutritional disorders, or drug or alcohol intoxication. It is also associated with brain tumors, abscesses, and congenital malformations.

Pathophysiology

Messages from the body are carried by the neurons (nerve cells) of the brain by discharges of electrochemical energy that sweep along them. These impulses occur in bursts whenever a nerve cell has a task to perform. Sometimes, these cells or groups of cells continue firing after a task is finished. During the period of unwanted discharges, parts of the body controlled by the errant cells may perform erratically. Resultant dysfunction ranges from mild to incapacitating and often causes loss of consciousness (Hickey, 2014). If these uncontrolled, abnormal discharges occur repeatedly, a person is said to have an epileptic syndrome. Epilepsy is not associated with intellectual level. People who have epilepsy without other brain or nervous system disabilities fall within the same intelligence ranges as the overall population. Epilepsy is not synonymous with intellectual or developmental disabilities, but many people who have these types of disabilities, because of serious neurologic damage, also have epilepsy (Fig. 49-12).

Epilepsy in Women

More than 1 million American women have epilepsy, and they face particular needs associated with the syndrome. Women with epilepsy often note an increase in seizure frequency during menses; this has been linked to the increase in sex hormones that alter the excitability of neurons in the cerebral cortex. The

Chart 49-4

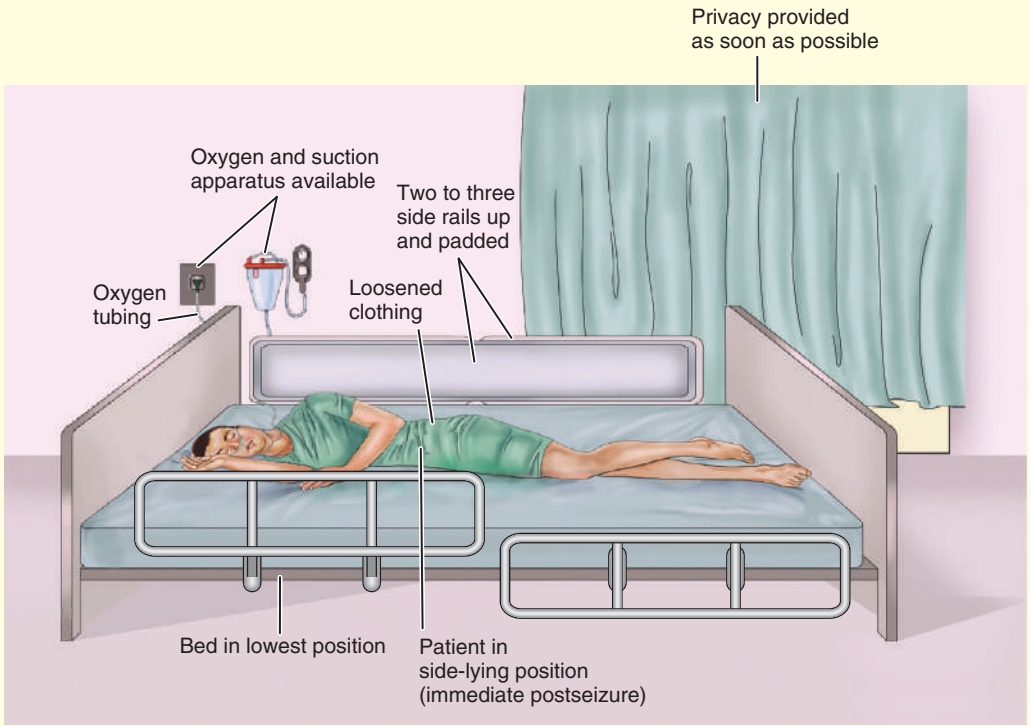
Care of the Patient During and After a Seizure

Nursing Care during a Seizure

- Provide privacy, and protect the patient from curious onlookers. (The patient who has an aura may have time to seek a safe, private place.)
- Ease the patient to the floor, if possible.
- Protect the head with a pad to prevent injury (from striking a hard surface).
- Loosen constrictive clothing and remove eyeglasses.
- Push aside any furniture that may injure the patient during the seizure.
- If the patient is in bed, remove pillows and raise side rails.
- *Do not attempt to pry open jaws that are clenched in a spasm or attempt to insert anything in the mouth during a seizure.* Broken teeth and injury to the lips and tongue may result from such an action.
- Do not attempt to restrain the patient during the seizure, because muscular contractions are strong and restraint can produce injury.
- If possible, place the patient on one side with head flexed forward, which allows the tongue to fall forward and facilitates drainage of saliva and mucus. If suction is available, use it if necessary to clear secretions.

Nursing Care after the Seizure

- Keep the patient on one side to prevent aspiration. Make sure the airway is patent.
- On awakening, reorient the patient to the environment.
- If the patient is confused or wandering, guide the patient gently to a bed or chair.
- If the patient becomes agitated after a seizure (postictal), stay a distance away, but close enough to prevent injury until the patient is fully aware.



Adapted from American Association of Neuroscience Nurses (AANN). (2016a). Care of adults and children with seizures and epilepsy: AANN clinical practice guideline series. Chicago, IL: Author.

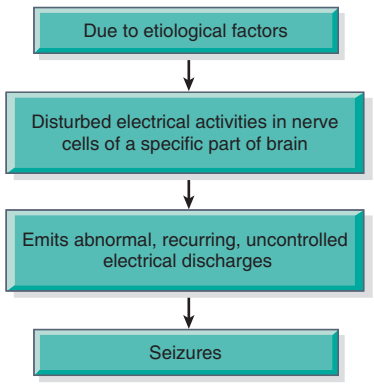


Figure 49-12 • Pathophysiology of epilepsy.

effectiveness of contraceptives is decreased by anticonvulsant medications. Therefore, patients should be encouraged to discuss family planning with their primary provider and to obtain preconception counseling if they are considering childbearing (Lagana, Triolo, D'Amico, et al., 2016).

Women of childbearing age who have epilepsy require special care and guidance before, during, and after pregnancy. Many women note a change in the pattern of seizure activity during pregnancy. The risk of congenital fetal anomaly is two to three times higher in women with epilepsy. Maternal seizures, anticonvulsant medications, and genetic predisposition all contribute to possible malformations. Women who take certain anticonvulsant medications for epilepsy are at risk and need careful monitoring, including blood studies to detect the level

of anticonvulsant medications taken throughout pregnancy. Mothers who are at high risk (teenagers, women with histories of difficult deliveries, women who use illicit drugs [e.g., "crack" cocaine, heroin], and women with diabetes or hypertension) should be identified and monitored closely during pregnancy, because damage to the fetus during pregnancy and delivery can increase the risk of epilepsy. All of these issues need further study (Lagana et al., 2016).

Because of bone loss associated with the long-term use of anticonvulsant medications, patients receiving anticonvulsant agents should be assessed for low bone mass and osteoporosis. They should be instructed about strategies to reduce their risks of osteoporosis (AANN, 2016a).

Gerontologic Considerations

Older adults have a high incidence of new-onset epilepsy (see Chart 49-5) (Hickey, 2014); (Miller, Buelow, & Bakas, 2014). Cerebrovascular disease is the leading cause of seizures in the older adult. The increased incidence is also associated with head injury, dementia, infection, alcoholism, and aging. Treatment depends on the underlying cause. Because many older adults have chronic health problems, they may be taking other medications that can interact with medications prescribed for seizure control. In addition, the absorption, distribution, metabolism, and excretion of medications are altered in the older adult as a result of age-related changes in renal and liver function. Therefore, older adult patients must be monitored closely for adverse and toxic effects of anticonvulsant medications and for osteoporosis. The cost of anticonvulsant medications can lead to poor adherence to the prescribed regimen in older adult patients on fixed incomes.

Prevention

Society-wide efforts are the key to prevention of epilepsy. Head injury is one of the main causes of epilepsy that can be prevented. Through highway safety programs and occupational safety precautions, lives can be saved and epilepsy due to head injury prevented; these programs are discussed in Chapter 51.

Medical Management

The management of epilepsy is individualized to meet the needs of each patient and not just to manage and prevent seizures. Management differs from patient to patient, because some forms of epilepsy arise from brain damage and others result from altered brain chemistry.

Pharmacologic Therapy

Many medications are available to control seizures, although the exact mechanisms of action are unknown. The objective is to achieve seizure control with minimal side effects. Medication therapy controls—rather than cures—seizures. Medications are selected on the basis of the type of seizure being treated and the effectiveness and safety of the medications. If properly prescribed and taken, medications control seizures in 70% to 80% of patients with seizures. However, 20% of patients with generalized seizures and 30% of those with focal seizures do not demonstrate improvement with any prescribed medication or may be unable to tolerate the side effects of medications (AANN, 2016a). Table 49-4 lists select anticonvulsant medications.

Treatment usually starts with a single medication. The starting dose and the rate at which the dosage is increased depend on the occurrence of side effects. The medication levels in the blood are monitored, because the rate of drug absorption varies among patients. Changing to another medication may be necessary if seizure control is not achieved or if toxicity makes it impossible to increase the dosage. The medication may need to be adjusted because of concurrent illness, weight changes, or increases in stress. Side effects of anticonvulsant medications may be divided into three groups: (1) idiosyncratic or allergic disorders, which manifest primarily as skin reactions; (2) acute toxicity, which may occur when the medication is initially

Chart 49-5 NURSING RESEARCH PROFILE

Experiences with a New Diagnosis of Epilepsy in Older Adults

Miller, W., Buelow, J., & Bakas, T. (2014). Older adults and new onset epilepsy: Experiences with diagnosis. Journal of Neuroscience Nursing, 46(1), 2–10.

Purpose

Older adults in the United States have a high rate of new-onset epilepsy; however, most research focuses on children and young adults. Older adults may exhibit a different clinical presentation, display age-related cognitive and metabolic changes, and have comorbidities that increase the likelihood of polypharmacy, creating unique challenges. This research was undertaken to identify the experience and characteristics of the older adult with new-onset epilepsy.

Design

A qualitative descriptive approach was undertaken to describe the experiences of 20 community dwelling older adults with new-onset epilepsy living in both urban and rural settings. Eligible participants were diagnosed at or after the age of 60 years, diagnosed within the previous 3 months, took at least one anticonvulsant medication, and spoke and read English. Semi-structured interviews were conducted by one researcher and analyzed and coded using conventional content analysis that identified clusters and themes.

Findings

The mean age of the participants was 70 years; 12 were women and 8 were men. Length of time until diagnosis was the most prominent theme during the interviews and split into two main themes: delayed diagnosis and nondelayed diagnosis. Participants with delayed diagnosis (epilepsy not diagnosed within 3 months of symptoms) attributed the delay to their primary providers not recognizing atypical symptoms or attributing symptoms to another neurologic process, or to their own delay in seeking care. The nondelayed participants reported typical seizure characteristics and rapid referral to a neurologic provider. The seizure events were obvious and interfered with daily life. Participants living in rural areas and women more often experienced delays in diagnosis.

Nursing Implications

Nurses need to be aware that older adults are the group at highest risk for developing new-onset epilepsy, and what might be identified as symptoms of aging may in fact be seizure-related events. Nurses can educate older adults regarding their risk of developing epilepsy and should describe both typical and atypical seizure presentations. Patients should be encouraged to seek specialized care for symptoms such as unexplained changes in mental status, syncopy, and dizziness.

TABLE 49-4 Select Anticonvulsant Medications

Medication	Dose-Related Side Effects	Toxic Effects
Carbamazepine (Tegretol)	Dizziness, drowsiness, unsteadiness, nausea and vomiting, diplopia, mild leukopenia	Severe skin rash, blood dyscrasias, hepatitis
Clonazepam (Klonopin)	Drowsiness, behavior changes, headache, hirsutism, alopecia, palpitations	Hepatotoxicity, thrombocytopenia, bone marrow failure, ataxia
Ethosuximide (Zarontin)	Nausea and vomiting, headache, gastric distress	Skin rash, blood dyscrasias, hepatitis, systemic lupus erythematosus
Felbamate (Felbatol)	Cognitive impairments, insomnia, nausea, headache, fatigue	Aplastic anemia, hepatotoxicity
Gabapentin (Neurontin)	Dizziness, drowsiness, somnolence, fatigue, ataxia, weight gain, nausea	Leukopenia, hepatotoxicity
Lamotrigine (Lamictal)	Drowsiness, tremor, nausea, ataxia, dizziness, headache, weight gain	Severe rash (Stevens–Johnson syndrome)
Levetiracetam (Keppra)	Somnolence, dizziness, fatigue	Unknown
Oxcarbazepine (Trileptal)	Dizziness, somnolence, double vision, fatigue, nausea, vomiting, loss of coordination, abnormal vision, abdominal pain, tremor, abnormal gait	Hepatotoxicity
Phenobarbital (Luminal)	Sedation, irritability, diplopia, ataxia	Skin rash, anemia
Phenytoin (Dilantin)	Visual problems, hirsutism, gingival hyperplasia, dysrhythmias, dysarthria, nystagmus	Severe skin reaction, peripheral neuropathy, ataxia, drowsiness, blood dyscrasias
Primidone (Mysoline)	Lethargy, irritability, diplopia, ataxia, impotence	Skin rash
Tiagabine (Gabitril)	Dizziness, fatigue, nervousness, tremor, difficulty concentrating, dysarthria, weak or buckling knees, abdominal pain	Unknown
Topiramate (Topamax)	Fatigue, somnolence, confusion, ataxia, anorexia, depression, weight loss	Nephrolithiasis
Valproate (Depakote, Depakene)	Nausea and vomiting, weight gain, hair loss, tremor, menstrual irregularities	Hepatotoxicity, skin rash, blood dyscrasias, nephritis
Zonisamide (Zonegran, Excegran)	Somnolence, dizziness, anorexia, headache, nausea, agitation, rash	Leukopenia, hepatotoxicity

Adapted from Karch, A. (2015). 2015 Lippincott's nursing drug guide. Philadelphia, PA: Lippincott Williams & Wilkins.

prescribed; and (3) chronic toxicity, which occurs late in the course of therapy.

The manifestations of drug toxicity are variable, and any organ system may be involved. For example, gingival hyperplasia (swollen and tender gums) can be associated with long-term use of phenytoin (Karch, 2015). Periodic physical and dental examinations and laboratory tests are performed for patients receiving medications that are known to have hematopoietic, genitourinary, or hepatic effects.

Surgical Management

Surgery is indicated for patients whose epilepsy results from intracranial tumors, abscesses, cysts, or vascular anomalies. Some patients have intractable seizure disorders that do not respond to medication. A focal atrophic process may occur secondary to trauma, inflammation, stroke, or anoxia. If the seizures originate in a reasonably well-circumscribed area of the brain that can be excised without producing significant neurologic deficits, the removal of the area generating the seizures may produce long-term control and improvement (AANN, 2016a).

This type of neurosurgery has been aided by several advances, including microsurgical techniques, EEGs with depth electrodes, improved illumination and hemostasis, and the introduction of neuroleptanalgesic agents (droperidol and fentanyl). These techniques, combined with the use of local anesthetic agents, enable the neurosurgeon to perform surgery on an alert and cooperative patient. Using special testing devices, electrocortical mapping, and the patient's responses to stimulation, the boundaries of the epileptogenic focus (i.e., abnormal area of the brain) are determined. Any abnormal epileptogenic focus is then excised (AANN, 2016a). Resection surgery significantly reduces the incidence of seizures in patients with refractory epilepsy.

When seizures are refractory to medication in adolescents and adults with focal seizures, a vagal nerve stimulator (VNS) may be implanted under the clavicle. The device is connected to the vagus nerve in the cervical area, where it delivers electrical signals to the brain to control and reduce seizure activity. An external programming system is used by the physician to change stimulator settings (Wheless, 2013). Patients can activate the stimulator with a magnet at the time of a seizure or aura. Some patients report that use of the vagal nerve stimulator diminishes the severity or duration of the seizure. Complications such as infection, cardiac dysrhythmias, hoarseness, cough, and laryngeal spasm can occur with the use of this device (AANN, 2016a); (Wheless, 2013).

Another surgical option for patients with refractory seizure activity is the responsive neurostimulation system (RNS) (U.S. Food and Drug Administration, 2014). This is a surgically implanted device with electrodes that sense and record brain electrical activity. Electrodes deliver an electrical stimulation to the location of seizure origination within the brain. The

RNS works by interrupting brainwave activity before a clinical seizure can occur (AANN, 2016a).

More research is needed to determine the effects of the various surgical approaches on complication rates, quality of life, anxiety, and depression, all of which are issues for patients with epilepsy.

NURSING PROCESS

The Patient with Epilepsy

Assessment

The nurse elicits information about the patient's seizure history. The patient is asked about the factors or events that may precipitate the seizures. Alcohol intake is documented. The nurse determines whether the patient has an aura before an epileptic seizure, which may indicate the origin of the seizure (e.g., seeing a flashing light may indicate that the seizure originated in the occipital lobe). Observation and assessment during and after a seizure assist in identifying the type of seizure and its management.

The effects of epilepsy on the patient's lifestyle are assessed (AANN, 2016a). What limitations are imposed by the seizure disorder? Does the patient participate in any recreational activities? Have any social contacts? Is the patient working, and is it a positive or stressful experience? What coping mechanisms are used?

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Risk for injury related to seizure activity
- Fear related to the possibility of seizures
- Ineffective individual coping related to stresses imposed by epilepsy
- Deficient knowledge related to epilepsy and anticonvulsant medications

Collaborative Problems/Potential Complications

The major potential complications for patients with epilepsy are status epilepticus and medication side effects (toxicity).

Planning and Goals

The major goals for the patient may include prevention of injury, control of seizures, achievement of a satisfactory psychosocial adjustment, acquisition of knowledge and understanding about the condition, and absence of complications.

Nursing Interventions

Preventing Injury

Injury prevention for the patient with seizures is a priority. Patients for whom seizure precautions are instituted should have pads applied to the side rails while in bed. Steps to prevent or minimize injury are presented in Chart 49-4.

Reducing Fear of Seizures

Fear that a seizure may occur unexpectedly can be reduced by the patient's adherence to the prescribed treatment regimen. Cooperation of the patient and family and their trust in the prescribed regimen are essential for control of seizures. The nurse emphasizes that the prescribed anticonvulsant medication must be taken on a continuing basis and that drug dependence or addiction does not occur. Periodic monitoring is necessary to ensure the adequacy of the treatment regimen, to prevent side effects, and to monitor for drug resistance (Hickey, 2014).

In an effort to control seizures, factors that may precipitate them are identified, such as emotional disturbances, new environmental stressors, onset of menstruation in female patients, or fever (AANN, 2016a). The patient is encouraged to follow a regular and moderate routine in lifestyle, diet (avoiding excessive stimulants), exercise, and rest (sleep deprivation may lower the seizure threshold). Moderate activity is therapeutic, but excessive exercise should be avoided. An additional dietary intervention, referred to as the ketogenic diet, may be helpful for control of seizures in some patients. This high-protein, low-carbohydrate, high-fat diet is most effective in children whose seizures have not been controlled with two anticonvulsant medications, but it is sometimes used for adults who have had poor seizure control (Nei, Ngo, Sirven, et al., 2014).

Photic stimulation (e.g., bright flickering lights, television viewing) may precipitate seizures; wearing dark glasses or covering one eye may be preventive. Tension states (anxiety, frustration) induce seizures in some patients. Classes in stress management may be of value. Because seizures are known to occur with alcohol intake, alcoholic beverages should be avoided.

Improving Coping Mechanisms

The social, psychological, and behavioral problems that frequently accompany epilepsy can be more of a disability than the actual seizures. Epilepsy may be accompanied by feelings of stigmatization, alienation, depression, and uncertainty (IOM, 2012). The patient must cope with the constant fear of a seizure and the psychological consequences (AANN, 2016a). Children with epilepsy may be ostracized and excluded from school and peer activities. These problems are compounded during adolescence and add to the challenges of dating, not being able to drive, and feeling different from other people. Adults face these problems in addition to the burden of finding employment, concerns about relationships and childbearing, insurance problems, and legal barriers. Alcohol abuse may complicate matters. Family reactions may vary from outright rejection of the person with epilepsy to overprotection.

Counseling assists the patient and family to understand the condition and the limitations it imposes. Social and recreational opportunities are necessary for good mental health. Nurses can improve the quality of life for patients with epilepsy by educating them and their families about symptoms and their management (AANN, 2016a).

Providing Patient and Family Education

Perhaps the most valuable facets of care contributed by the nurse to the person with epilepsy are education and efforts to modify the attitudes of the patient and family toward the disorder. The person who experiences seizures may consider every seizure a potential source of humiliation and shame. This may result in anxiety, depression, hostility, and secrecy on the part of the patient and family. Ongoing education and encouragement should be given to patients to enable them to overcome these reactions. The patient with epilepsy should carry an emergency medical identification card or wear a medical information bracelet. The patient and family need to be educated about medications as well as care during a seizure.

Monitoring and Managing Potential Complications

Status epilepticus is the major potential complication and is described later in this chapter. Another complication is the toxicity of medications. The patient and family are instructed about side effects and are given specific guidelines to assess and report signs and symptoms that indicate medication overdose.

Anticonvulsant medications require careful monitoring for therapeutic levels. The patient should plan to have serum drug levels assessed at regular intervals. Many known drug interactions occur with anticonvulsant medications. A complete pharmacologic profile should be reviewed with the patient to avoid interactions that either potentiate or inhibit the effectiveness of the medications.

Nursing Alert: Patients with epilepsy are at risk for status epilepticus from having their medication regimen interrupted.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. Thorough oral hygiene after each meal, gum massage, daily flossing, and regular dental care are essential to prevent or control gingival hyperplasia in patients receiving phenytoin. The patient is also educated to inform all health care providers of the medication being taken, because of the possibility of drug interactions. An individualized comprehensive education plan is needed to assist the patient and family to adjust to this chronic disorder. Written patient education materials must be appropriate for the patient's reading level and must be provided in alternative formats if warranted.

Continuing and Transitional Care. Because epilepsy can be lifelong, health promotion is important. See Chart 49-6 for health promotion strategies for the patient with epilepsy.

Patients who have uncontrollable seizures accompanied by psychological and social difficulties should be referred as early as possible to a comprehensive epilepsy center where continuous audio-video and EEG monitoring, specialized treatment, and rehabilitation services are available (AANN, 2016a). Patients and their families need to be reminded of the importance of participating in health promotion activities and recommended health screenings to promote a healthy lifestyle. Genetic and preconception counseling is advised.

Chart 49-6 HEALTH PROMOTION

Strategies for the Patient with Epilepsy

- Take anticonvulsant medications daily as prescribed to keep the drug level constant to prevent seizures. Never discontinue medications, even if there is no seizure activity.
- Keep a medication and seizure record (in electronic or paper format), noting when medications are taken and any seizure activity.
- Notify the primary provider if unable to take medications due to illness.
- Have anticonvulsant medication serum levels checked regularly. When testing is prescribed, report to the laboratory for blood sampling before taking morning medication.
- Avoid activities that require alertness and coordination (driving, operating machinery) until after the effects of the medication have been evaluated.
- Report signs of toxicity so that dosage can be adjusted. Common signs include drowsiness, lethargy, dizziness, difficulty walking, hyperactivity, confusion, inappropriate sleep, and visual disturbances.
- Avoid over-the-counter medications unless approved by the primary provider.
- Carry a medical alert bracelet or identification card specifying the name of the anticonvulsant medication and primary provider.
- Avoid seizure triggers, such as alcoholic beverages, electrical shocks, stress, caffeine, constipation, fever, hyperventilation, and hypoglycemia.
- Take showers rather than tub baths to avoid drowning if seizure occurs; never swim alone.
- Exercise in moderation in a temperature-controlled environment to avoid excessive heat.
- Develop regular sleep patterns to minimize fatigue and insomnia.

Evaluation

Expected patient outcomes may include:

1. Sustains no injury during seizure activity
   a. Adheres to treatment regimen and identifies the hazards of stopping the medication
   b. Can identify appropriate care during seizure; caregivers can do so as well
2. Indicates a decrease in fear
3. Displays effective individual coping
4. Exhibits knowledge and understanding of epilepsy
   a. Identifies the side effects of medications
   b. Avoids factors or situations that may precipitate seizures (e.g., flickering lights, hyperventilation, alcohol)
   c. Follows a healthy lifestyle by getting adequate sleep and eating meals at regular times to avoid hypoglycemia
5. Absence of complications

Status Epilepticus

Status epilepticus (acute prolonged seizure activity) is a series of generalized seizures that occur without full recovery of consciousness between attacks (Trinka, Cock, Hesdorffer, et al., 2015). The term has been broadened to include continuous clinical or electrical seizures (on EEG) lasting at least 30 minutes, even without impairment of consciousness. It is considered a medical emergency. Status epilepticus produces cumulative effects. Vigorous muscular contractions impose a heavy metabolic demand and can interfere with respirations. Some respiratory arrest at the height of each seizure produces venous congestion and hypoxia of the brain. Repeated episodes of cerebral anoxia and edema may lead to irreversible and fatal brain damage. Factors that precipitate status epilepticus include interruption of anticonvulsant medication, fever, concurrent infection, or other illness.

Medical Management

The goals of treatment are to stop the seizures as quickly as possible, to ensure adequate cerebral oxygenation, and to maintain the patient in a seizure-free state. An airway and adequate oxygenation are established. If the patient remains unconscious and unresponsive, an endotracheal tube is inserted. IV diazepam (Valium), lorazepam (Ativan), or fosphenytoin is given slowly in an attempt to halt seizures immediately. Other medications (phenytoin, phenobarbital) are given later to maintain a seizure-free state.

An IV line is established, and blood samples are obtained to monitor serum electrolytes, glucose, and phenytoin levels. EEG monitoring may be useful in determining the nature of the seizure activity. Vital signs and neurologic signs are monitored on a continuing basis. An IV infusion of dextrose is given if the seizure is caused by hypoglycemia. If initial treatment is unsuccessful, general anesthesia with a short-acting barbiturate

may be used. The serum concentration of the anticonvulsant medication is measured, because a low level suggests that the patient was not taking the medication or that the dosage was too low. Cardiac involvement or respiratory depression may be life threatening. The potential for postictal cerebral edema also exists.

Nursing Management

The nurse initiates ongoing assessment and monitoring of respiratory and cardiac function because of the risk for delayed depression of respiration and blood pressure secondary to administration of anticonvulsant medications and sedatives to halt the seizures. Nursing assessment also includes monitoring and documenting the seizure activity and the patient's responsiveness.

The patient is turned to a side-lying position, if possible, to assist in draining pharyngeal secretions. Suction equipment must be available because of the risk of aspiration. The IV line is closely monitored, because it may become dislodged during seizures.

A person who has received long-term anticonvulsant therapy has a significant risk for fractures resulting from bone disease (osteoporosis, osteomalacia, and hyperparathyroidism), which is a side effect of therapy (Karch, 2015). Therefore, during seizures, the patient is protected from injury with the use of seizure precautions and is monitored closely. The patient having seizures can inadvertently injure nearby people, so nurses should protect themselves. Additional nursing interventions for the person having seizures are presented in Chart 49-4.

HEADACHE

Headache, or cephalalgia, is one of the most common of all human physical complaints. Headache is a symptom rather than a disease entity; it may indicate organic disease (neurologic or other disease), a stress response, vasodilation (migraine), skeletal muscle tension (tension headache), or a combination of factors. A primary headache is one for which no organic cause can be identified. This type of headache includes migraine, tension-type, and cluster headaches (Hickey, 2014). Cranial arteritis is another common cause of headache. A classification of headaches was issued first by the Headache Classification Committee of the International Headache Society in 1988. The International Headache Society revised the headache classification in (2013); an abbreviated list is shown in Chart 49-7.

Migraine is a complex of symptoms characterized by periodic and recurrent attacks of severe headache lasting from hours to days in adults. The cause of migraine has not been clearly demonstrated, but it is primarily a vascular disturbance that has a strong familial tendency. The typical time of onset is at puberty, and the incidence is higher in women than men (D'Arcy, 2014).

There are many subtypes of migraine headache, including migraine with and without aura. Most patients have migraine without an aura. *Tension-type headaches* tend to be chronic and less severe and are probably the most common type of headache. *Trigeminal autonomic cephalalgias* include cluster headaches and paroxysmal hemicrania. Cluster headaches are relatively uncommon and seen more frequently in men than in women (Grossman & Porth, 2014). Types of headaches not subsumed under these categories fall into the *other primary headache* group and include headaches triggered by cough, exertion, and sexual activity.

Chart 49-7

International Headache Society Classification of Headache

1. Migraine
2. Tension-type headache
3. Trigeminal autonomic cephalalgias
4. Other primary disorders
5. Headache attributed to trauma or injury to the head and/or neck
6. Headache attributed to cranial or cervical vascular disorder
7. Headache attributed to nonvascular intracranial disorder
8. Headache attributed to a substance or its withdrawal
9. Headache attributed to infection
10. Headache attributed to disorder of homeostasis
11. Headache or facial pain attributed to disorder of cranium, neck, eyes, ears, nose, sinuses, teeth, mouth, or other facial or cranial structures
12. Headache attributed to psychiatric disorder
13. Painful cranial neuropathies and other facial pains
14. Other headache disorders

Adapted from Headache Classification Subcommittee of the International Headache Society. (2013). The International Classification of Headache Disorders, 3rd edition (beta version). Cephalalgia, 33(9), 629–808.

Cranial arteritis is a cause of headache in the older population, reaching its greatest incidence in those older than 70 years of age. Inflammation of the cranial arteries is characterized by a severe headache localized in the region of the temporal arteries. The inflammation may be generalized (in which case cranial arteritis is part of a vascular disease) or focal (in which case only the cranial arteries are involved).

A secondary headache is a symptom associated with other causes, such as a brain tumor, an aneurysm, or lumbar puncture (Destrebecq, Terzoni, & Sala, 2014). Although most headaches do not indicate serious disease, persistent headaches require further investigation. Serious disorders related to headache include brain tumors, subarachnoid hemorrhage, stroke, severe hypertension, meningitis, and head injuries.

Pathophysiology

The cerebral signs and symptoms of migraine result from a hyperexcitable brain that is susceptible to a phenomenon known as cortical spreading depression, a wave of depolarization over the cerebral cortex, cerebellum, and hippocampus. This depolarization activates inflammatory neuropeptides and other neurotransmitters (including serotonin), resulting in the stimulation of meningeal nociceptors. Vascular changes, inflammation, and a continuation of pain signal stimulation occur (Charles, 2015). The initial phase of this process is known as the premonitory phase and may include light, sound, and smell sensitivity. If treatment is initiated at this point, the migraine may be fully terminated. As the attack progresses, central sensitization occurs, and the migraine becomes much harder to treat.

Attacks can be triggered by hormonal changes associated with menstrual cycles, bright lights, stress, depression, sleep deprivation, fatigue, or odors. Certain foods containing tyramine (especially aged cheese), monosodium glutamate, and chocolate may be food triggers (Grossman & Porth, 2014). The use of oral contraceptives may be associated with increased frequency and severity of attacks in some women.

Emotional or physical stress may cause contraction of the muscles in the neck and scalp, resulting in tension headache.

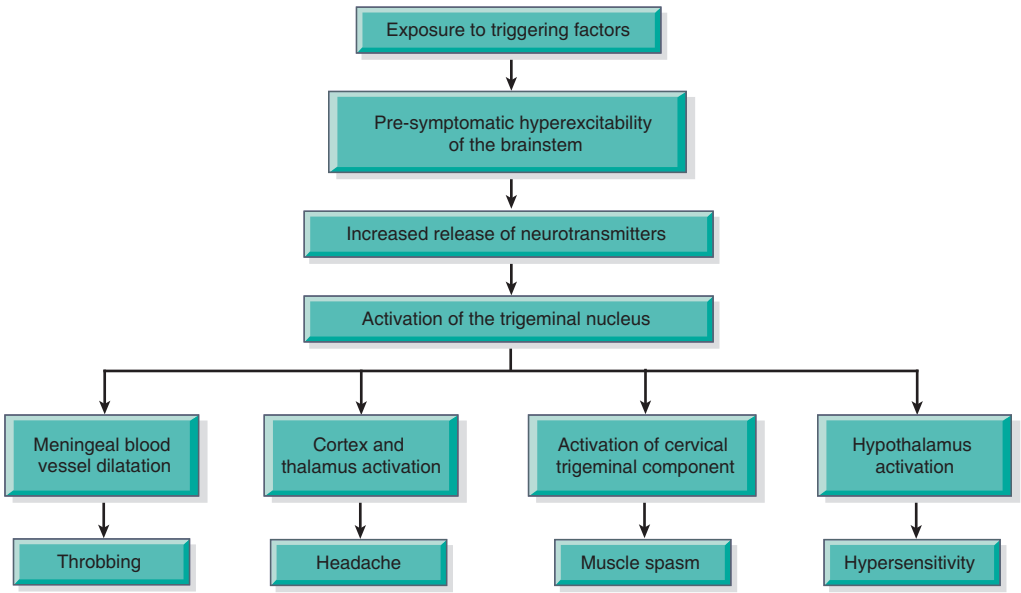


Figure 49-13 • Pathophysiology of headache.

The pathophysiology of cluster headache is not fully understood. One theory is that it is caused by dilation of orbital and nearby extracranial arteries. Cranial arteritis is thought to represent an immune vasculitis in which immune complexes are deposited within the walls of affected blood vessels, producing vascular injury and inflammation. A biopsy may be performed on the involved artery to make the diagnosis. A flowchart for pathophysiology of headache is presented in Figure 49-13.

Clinical Manifestations

Migraine

The migraine with aura can be divided into four phases: premonitory, aura, the headache, and recovery (headache termination and postdrome).

Premonitory Phase

The premonitory phase is experienced by more than 80% of adult migraine sufferers, with symptoms that occur hours to days before a migraine headache (Charles, 2013). Symptoms may include depression, irritability, feeling cold, food cravings, anorexia, change in activity level, increased urination, diarrhea, or constipation. Patients may experience the same prodrome with each migraine headache. A current theory regarding premonitory symptoms is that they involve the neurotransmitter dopamine.

Aura Phase

An aura may be a variable feature for patients who experience migraines (Charles & Hansen, 2015). An aura is characterized by focal neurologic symptoms. Visual disturbances (i.e., light flashes and bright spots) are most common and may be hemianopic (affecting only half of the visual field). Other symptoms that may follow include numbness and tingling of the lips, face, or hands; mild confusion; slight weakness of an extremity; drowsiness; and dizziness.

This period of aura was thought to correspond to the phenomenon of cortical spreading depression that is associated with reduced metabolic demand in abnormally functioning neurons. This can be associated with decreased blood flow; however, cerebral blood flow studies performed during migraine headaches demonstrate that although changes in blood vessels occur during phases of migraine, cerebral blood flow is not the main abnormality. In fact, some studies suggest that the aura and headache phases may occur simultaneously (Charles, 2013).

Headache Phase

Migraine headache is severe and incapacitating and is often associated with photophobia (light sensitivity), phonophobia (sound sensitivity), or allodynia (abnormal perception of innocuous stimuli) (Charles, 2013). Research differs in the role of vascular changes (either vasodilatory or vasoconstrictive) with respect to migraine pathophysiology and the experience of migraine headache. Symptoms of migraine can also include nausea and vomiting.

Postdrome Phase

In the postdrome phase, the pain gradually subsides, but patients may experience tiredness, weakness, cognitive difficulties, and mood changes for hours to days. Muscle contraction in the neck and scalp is common, with associated muscle ache and localized tenderness. Physical exertion may exacerbate the headache pain. During this postheadache phase, patients may sleep for extended periods.

Other Headache Types

The tension-type headache is characterized by a steady, constant feeling of pressure that usually begins in the forehead, temple, or back of the neck. It is often bandlike or may be described as "a weight on top of my head."

Cluster headaches are unilateral and come in clusters of one to eight daily, with excruciating pain localized to the eye and orbit and radiating to the facial and temporal regions. The pain is accompanied by watering of the eye and nasal congestion. Each attack lasts 15 minutes to 3 hours and may have a crescendo–decrescendo pattern (Hickey, 2014). The headache is often described as penetrating.

Cranial arteritis often begins with general manifestations, such as fatigue, malaise, weight loss, and fever. Clinical

manifestations associated with inflammation (heat, redness, swelling, tenderness, or pain over the involved artery) usually are present. Sometimes a tender, swollen, or nodular temporal artery is visible. Visual problems are caused by ischemia of the involved structures.

Assessment and Diagnostic Findings

The diagnostic evaluation includes a detailed history, a physical assessment of the head and neck, and a complete neurologic examination. Headaches may manifest differently in the same person over the course of a lifetime, and the same type of headache may manifest differently from patient to patient. The health history focuses on assessing the headache itself, with emphasis on the factors that precipitate or provoke it. The patient is asked to describe the headache in their own words.

Because headache is often the presenting symptom of a wider variety of physiologic and psychological disturbances, a general health history is an essential component of the patient database. Therefore, questions addressed in the health history should cover major medical and surgical illness as well as a body systems review.

The medication history can provide insight into the patient's overall health status and indicate medications that may be provoking headaches. Antihypertensive agents, diuretic medications, anti-inflammatory agents, and monoamine oxidase (MAO) inhibitors are a few of the categories of medications that can provoke headaches. Daily use of over-the-counter or prescribed pain medications for 8 to 10 days out of a month can lead to a chronic headache due to medication overuse (Becker, Findlay, Moga, et al., 2015). Emotional factors can play a role in precipitating headaches. Stress is thought to be a major initiating factor in migraine headaches; therefore, sleep patterns, level of stress, recreational interests, appetite, emotional problems, and family stressors are relevant. There is a strong familial tendency for headache disorders, and a positive family history may help in making a diagnosis.

A direct relationship may exist between exposure to toxic substances and headache. Careful questioning may uncover chemicals to which a worker has been exposed. Under the Right-to-Know Law, employees have access to the material safety data sheets (commonly referred to as MSDS) for all substances with which they come in contact in the workplace (see Chapter 64). The occupational history also includes assessment of the workplace as a possible source of stress and for a possible ergonomic basis of muscle strain and headache.

A complete description of the headache itself is crucial. The nurse reviews the age at onset of headaches; this particular headache's frequency, location, and duration; the type of pain; factors that relieve and precipitate the event; and associated symptoms. The data obtained should include the patient's own words about the headache in response to the following questions:

- What is the location? Is it unilateral or bilateral? Does it radiate?
- What is the quality—dull, aching, steady, boring, burning, intermittent, continuous, paroxysmal?
- How many headaches occur during a given period of time?
- What are the precipitating factors, if any—environmental (e.g., sunlight, weather change), foods, exertion, other?
- What makes the headache worse (e.g., coughing, straining)?
- What time (day or night) does it occur?
- How long does a typical headache last?
- Are there any associated symptoms, such as facial pain, lacrimation (excessive tearing), or scotomas (blind spots in the field of vision)?
- What usually relieves the headache (aspirin, nonsteroidal anti-inflammatory drugs, ergot preparation, food, heat, rest, neck massage)?
- Does nausea, vomiting, weakness, or numbness in the extremities accompany the headache?
- Does the headache interfere with daily activities?
- Do you have any allergies?
- Do you have insomnia, poor appetite, loss of energy?
- Is there a family history of headache?
- What is the relationship of the headache to your lifestyle or physical or emotional stress?
- What medications are you taking?

Diagnostic testing often is not helpful in the investigation of headache, because usually there are few objective findings. In patients who demonstrate abnormalities on the neurologic examination, CT scan, cerebral angiography, or MRI scan may be used to detect underlying causes, such as tumor or aneurysm. Electromyography (EMG) may reveal a sustained contraction of the neck, scalp, or facial muscles. Laboratory tests may include complete blood count, erythrocyte sedimentation rate, electrolytes, glucose, creatinine, and thyroid hormone levels.

Prevention

Prevention begins by having the patient avoid specific triggers that are known to initiate the headache syndrome. Preventive medical management of migraine involves the daily use of one or more agents that are thought to block the physiologic events leading to an attack. Treatment regimens vary greatly, as do patient responses; therefore, close monitoring is indicated.

Alcohol, nitrites, vasodilators, and histamines may precipitate cluster headaches. Elimination of these factors helps prevent the headaches.

Medical Management

Therapy for migraine headache is divided into abortive (symptomatic) and preventive approaches. The abortive approach, best used in those patients who have less frequent attacks, is aimed at relieving or limiting a headache at the onset or while it is in progress. The preventive approach is used in patients who experience more frequent attacks at regular or predictable intervals and may have a medical condition that precludes the use of abortive therapies (Becker et al., 2015). Medical management of migraine during pregnancy and lactation includes nonpharmacologic strategies in addition to safe medication practices (Wells, Turner, Lee, et al., 2016). Nonpharmacologic treatments include mainly avoidance of triggers (Grossman & Porth, 2014) (see Chart 49-8).

The triptans, which are serotonin receptor agonists, are the most specific antimigraine agents available. These agents cause vasoconstriction, reduce inflammation, and may reduce pain transmission. The five triptans in routine clinical use include sumatriptan (Imitrex), naratriptan (Amerge), rizatriptan (Maxalt), zolmitriptan (Zomig), and almotriptan (Axert) (D'Arcy, 2014). Numerous serotonin receptor agonists are under study. Many of the triptan medications are available in a variety of formulations, such as nasal sprays, inhalers, conventional tablet, disintegrating tablet, suppositories, or injections. The nasal sprays are useful

Chart 49-8 PATIENT EDUCATION

Migraine Headaches

The nurse instructs the patient to:

- Be aware of the definition of migraine headaches along with the characteristics and manifestations.
- Recognize triggers of migraine headaches and how to avoid such triggers as:
  - Foods that contain tyramine, such as chocolate, cheese, coffee, dairy products
  - Dietary habits that result in long periods between meals
  - Menstruation and ovulation (caused by hormone fluctuation)
  - Alcohol (causes vasodilation of blood vessels)
  - Fatigue and fluctuations in sleep patterns
- Develop and use a paper or electronic headache diary.
- Implement stress management and lifestyle changes to minimize the frequency of headaches.
- Ensure correct pharmacologic management: acute therapy and prophylaxis to include medication regimen and side effects.
- Use comfort measures during headache attacks, such as resting in a quiet and dark environment, applying cold compresses to the painful area, and elevating the head.

for patients experiencing nausea and vomiting (Dahlöf & Van Den Brink, 2012).

The triptans are considered first-line treatment of the management of moderate to severe migraine pain. Best results are achieved with early use of triptans; oral dosing takes effect within 20 to 60 minutes of taking the drug and if needed may be repeated in 2 to 4 hours. Triptans are contraindicated in patients with ischemic heart disease. Careful administration and dosing instructions to patients are important to prevent adverse reactions such as increased blood pressure, drowsiness, muscle pain, sweating, and anxiety. Interactions are possible if the medication is taken in conjunction with St. John wort (Karch, 2015).

Ergotamine preparations (taken orally, sublingually, subcutaneously, intramuscularly, by rectum, or by inhalation) may be effective in aborting the headache if taken early in the migraine process. They are low in cost. Ergotamine tartrate acts on smooth muscle, causing prolonged constriction of the cranial blood vessels. Each patient's dosage is based on individual needs. Side effects include aching muscles, paresthesias (numbness and tingling), nausea, and vomiting. Pretreatment with antiemetic agents may be required. None of the triptan medications should be taken concurrently with medications containing ergotamine because of the potential for a prolonged vasoactive reaction (Karch, 2015).

Many widely used medications for the prevention of migraine are available. An analysis of research in the last decade reported the most effective medications for migraine treatment include anticonvulsant agents (divalproex sodium [Depakote], valproate [Depacon], topiramate [Topamax]), beta-blockers (metoprolol [Lopressor], propranolol [Inderal], timolol [Blocadren]), and triptans (frovatriptan [Frova]). Other medications prescribed for migraine prevention include antidepressant agents (amitriptyline [Elavil], venlafaxine [Effexor]) and additional beta-blockers (atenolol [Tenormin], nadolol [Corgard]) and triptans (naratriptan [Amerge], zolmitriptan [Zomig]) (D'Arcy, 2014).

The medical management of an acute attack of cluster headaches may include 100% oxygen by facemask for 15 minutes, subcutaneous sumatriptan, or intranasal zolmitriptan (Becker et al., 2015).

The medical management of cranial arteritis consists of early administration of a corticosteroid to prevent the possibility of loss of vision due to vascular occlusion or rupture of the involved artery. The patient is instructed not to stop the medication abruptly, because this can lead to relapse. Analgesic agents are prescribed for comfort.

Nursing Management

When migraine or the other types of headaches have been diagnosed, the goal of nursing management is pain relief. It is reasonable to try nonpharmacologic interventions first, but the use of medications should not be delayed. The first priority is to treat the acute event of the headache and the second is to prevent recurrent episodes. Prevention involves patient education regarding precipitating factors, possible lifestyle or habit changes that may be helpful, and pharmacologic measures.

Relieving Pain

Individualized treatment depends on the type of headache and differs for migraine, cluster headaches, cranial arteritis, and tension headache. Nursing care is directed toward treatment of the acute episode. A migraine or a cluster headache in the early phase requires abortive medication therapy instituted as soon as possible. Some headaches can be prevented if the appropriate medications are taken before the onset of pain. Nursing care during an attack includes comfort measures such as a quiet, dark environment; elevation of the head of the bed to 30 degrees; and symptomatic treatment (i.e., administration of antiemetic medication) (Hickey, 2014).

Symptomatic pain relief for tension headache may be obtained by application of local heat or massage. Additional strategies may include administration of analgesic agents, antidepressant medications, and muscle relaxants.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care

Headaches, especially migraines, are more likely to occur when the patient is ill, overly tired, or stressed. Nonpharmacologic therapies are important and include patient education about the type of headache, its mechanism (if known), and appropriate changes in lifestyle to avoid triggers. Regular sleep, meals, exercise, relaxation, and avoidance of dietary triggers may be helpful in avoiding headaches (Becker et al., 2015).

The patient with tension headaches needs education and reassurance that the headache is not the result of a brain tumor or other intracranial disorder. Stress reduction techniques, such as biofeedback, exercise programs, and meditation, are examples of nonpharmacologic therapies that may prove helpful. The patient and family need to be educated about the importance of following the prescribed treatment regimen for headache and keeping follow-up appointments. In addition, the patient is reminded of the importance of participating in health promotion activities and recommended health screenings to promote a healthy lifestyle. Chart 49-8 presents educational topics for the patient with migraine headaches.

CRITICAL THINKING EXERCISES

1. A patient is admitted to your unit for a transsphenoidal cranial procedure. Identify the nursing interventions indicated before, during, and after the procedure. What patient and caregiver education is indicated in preparation for discharge? How will your nursing interventions and patient education change if a supratentorial surgical approach is used?

2. As a member of Hospital Quality Improvement Committee, you are working on updating interventions to manage increased intracranial pressure. Using your knowledge of evidence-based practice guidelines, list the most important interventions for nurses to implement. Compare and contrast the options supported by the guidelines.
3. Identify the priorities, approach, and techniques you would use to provide care to a 25-year-old female patient with migraine headaches. How will your priorities, approach, and techniques differ if the patient is male, if the patient has tension-type or cluster headaches?

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

American Association of Neuroscience Nurses (AANN). (2012). Care of the patient with intracranial pressure monitoring/external ventricular drainage or lumbar drainage: AANN clinical practice guideline series. Glenview, IL: Author.

American Association of Neuroscience Nurses (AANN). (2016a). Care of adults and children with seizures and epilepsy: AANN clinical practice guideline series. Chicago, IL: Author.

American Association of Neuroscience Nurses (AANN). (2016b). Care of the adult patient with a brain tumor: AANN clinical practice guideline series. Chicago, IL: Author.

Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Grossman, S. C., & Porth, C. M. (2014). Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Karch, A. (2015). 2015 Lippincott's nursing drug guide. Philadelphia, PA: Lippincott Williams & Wilkins.

**Posner, J. B., Saper, C. B., Schiff, N. D., et al. (2007). Plum and Posner's diagnosis of stupor and coma (4th ed.). Oxford, UK: Oxford University Press.

Wheless, J. (2013). Vagus nerve stimulation therapy. In E. Wyllie, G. D. Cascino, B. E. Gidal, & H. P. Goodkin (Eds.). Wyllie's treatment of epilepsy: Principles and practice (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

Alali, A., Naimark, D., Wilson, J., et al. (2014). Economic evaluation of decompressive hemicraniectomy versus barbiturate coma for refractory intracranial hypertension following traumatic brain injury. Critical Care Medicine, 42(10), 2235–2243.

Amudhan, S., Gururaj, G., & Satishchandra, P. (2015). Epilepsy in India I: Epidemiology and public health. Annals of Indian Academy of Neurology, 18(3), 263.

Andrews, P., Sinclair, L., Rodriguez, A., et al. (2015). Hypothermia for intracranial hypertension after traumatic brain injury. The New England Journal of Medicine, 373(25), 2403–2412.

Aylwin, S., Burst, V., Peri, A., et al. (2015). "Do's and dont's" in the management of hyponatremia. Current Medical Research and Opinion, 31(9), 1755–1761.

Bauman, M., & McCourt, T. R. (2014). Assessing and managing patients with chronic subdural hematoma, American Nurse Today, 9(9), 38–41.

Becker, W., Findlay, T., Moga, C., et al. (2015). Guideline for primary care management of headache in adults. Canadian Family Physician, 61(8), 670–679.

Bruno, M., Laureys, S., & Demerttzi, A. (2013). Coma and disorders of consciousness. Handbook of Clinical Neurology, 118(2013), 205–213.

Charles, A. (2013). The evolution of migraine attack – a review of recent evidence. Headache, 53(2), 413–419.

Charles, A. (2015). Sounding out migraine-related interactions between the brainstem and the cortex. Cephalalgia, 35(11), 941–943.

Charles, A., & Hansen, J. (2015). Migraine aura: New ideas about cause, classification, and clinical significance. Current Opinion in Neurology, 28(3), 255–260.

Dahlöf, C., & Van Den Brink, A. (2012). Dihydroergotamine, ergotamine, methysergide and sumatriptan – basic science in relation to migraine treatment. Headache, 52(4), 707–714.

D'Arcy, Y. (2014). Preventing migraine headaches in adults. Nursing 2014, 44(1), 58–61.

de Lima Oliveira, M., Kairalla, A., Fonoff, E., et al. (2014). Cerebral microdialysis in traumatic brain injury and subarachnoid hemorrhage: State of the art. Neurocritical Care, 21(1), 152–162.

Destrebecq, A., Terzoni, S., & Sala, E. (2014). Post-lumbar puncture headache: A review of issues for nursing practice. Journal of Neuroscience Nursing, 46(3), 180–186.

Dias, C., Maia, I., Cerejo, A., et al. (2014) Pressures, flow, and brain oxygenation during plateau waves of intracranial pressure. Neurocritical Care, 21(1), 124–132.

England, M., Liverman, C., Schultz, A., et al. (2012). Epilepsy across the spectrum: Promoting health and understanding. A summary of the Institute of Medicine report. Epilepsy and Behavior, 25(2), 266–276.

Fisher, R., Acevedo, C., Arzimanoglou, A., et al. (2014). A practical clinical definition of epilepsy. Epilepsia, 55(4), 475–482.

Fisher, R., Cross, H., French, J., et al. (2016). Operational classification of seizure types by the International League Against Epilepsy (ILAE). Retrieved on 9/29/2016 at: www.ilae.org/visitors/centre/documents/ClassificationSeizureILAE-2016.pdf

Foreman, P., Schmalz, P., & Griessenauer, C. (2014). Chemoprophylaxis for venous thromboembolism in traumatic brain injury: A review and evidence based protocol. Clinical Neurology and Neurosurgery, 123, 109–116.

GBD Arrow Diagram. (n.d.). Retrieved February 25, 2018, from http://www.healthmetricsandevaluation.org/gbd/visualizations/gbd-arrow-diagram.

Headache Classification Committee of the International Headache Society. (2013). The international classification of headache disorders, 3rd edition (beta version). Cephalalgia, 33(9), 629–808.

Institute of Medicine (IOM). (2012). Epilepsy across the spectrum: Promoting health and understanding. Retrieved on 1/5/17 at: www.nationalacademies.org/hmd/Reports/2012/Epilepsy-Across-the-Spectrum.aspx.

Kiyoshi-Teo, H., & Blegen, M. (2015). Influence of institutional guidelines on oral hygiene practices in intensive care units. American Journal of Critical Care, 24(4), 309–318.

Lagana, A., Triolo, O., D'Amico, V., et al. (2016). Management of women with epilepsy: From preconception to post-partum. Archives of Gynecology and Obstetrics, 293, 493–503.

Madden, L., & DeVon, H. (2015). A systematic review of the effects of body temperature on outcome after adult traumatic brain injury. Journal of Neuroscience Nursing, 47(4), 190–203.

Majdan, M., Mauritz, W., Wilbacher, I., et al. (2013). Barbiturates use and its effects in patients with severe traumatic brain injury in five European countries. Journal of Neurotrauma, 30(1), 23–29.

Megha, M., Harpreet, S., & Nayeem, Z. (2013). Effect of frequency of multimodal coma stimulation on the consciousness levels of traumatic brain injury comatose patients. Brain Injury, 27(5), 570–577.

*Miller, W., Buelow, J., & Bakas, T. (2014). Older adults and new onset epilepsy: Experiences with diagnosis. Journal of Neuroscience Nursing, 46(1), 2–10.

*Mitchell, P., Kirkness, C., & Blissitt, P. (2015). Chapter 5 cerebral perfusion pressure and intracranial pressure in traumatic brain injury. Annual Review of Nursing Research, 33, 111–117.

Munro, N., & Ruggiero, M. (2014). Ventilator-associated pneumonia bundle. AACN Advanced Critical Care, 25(2), 163–175.
Nei, M., Ngo, L., Sirven, J., et al. (2014). Ketogenic diet in adolescents and adults with epilepsy. Seizure, 23(6), 439–442.
Nemer, S., Caldeira, J., Santos, R., et al. (2015). Effects of positive end-expiratory pressure on brain tissue oxygen pressure of severe traumatic brain injury patients with acute respiratory distress syndrome – A pilot study. Journal of Critical Care, 30(6), 1263–1266.
Oddo, M., Bosel, J., & Participants in the International Multidisciplinary Consensus Conference on Multimodality Monitoring. (2014). Monitoring of brain and systemic oxygenation in neurocritical care patients. Neurocritical Care, 21(Supp 2), S103–S120.
Ong, C., Keyrouz, S., & Diringer, M. (2015). The role of osmotic therapy in hemispheric stroke. Neurocritical Care, 23(2), 285–291.
Rockett, H., Thompson, H., & Blissitt, P. (2015). Fever management: Practices of neuroscience nurses: What has changed?. Journal of Neuroscience Nursing, 47(2), 66–75.
Sander, J. W. (2004). The use of antiepileptic drugs—principles and practice. Epilepsia, 45(s6), 28–34.
Sandsmark, D., Kumar, M., Park, S., et al. (2012). Multimodal monitoring in subarachnoid hemorrhage. Stroke, 43(5), 1440–1445.
Scheffer, I., French, J., Hirsch, E., et al. (2016). Classification of the epilepsies: New concepts for discussion and debate – special report of the ILAE classification task force of the commission for classification and terminology. Epilepsia Open, 1–8. doi:10.1002/epi4.5.
Thibault, A., Deltombe, T., Wannez, S., et al. (2015). Impact of soft splints on upper limb spasticity in chronic patients with disorders of consciousness: A randomized, single-blind, controlled trial. Brain Injury, 29(7–8), 830–836.
Trinka, E., Cock, H., Hesdorffer, D., et al. (2015). A definition and classification of status epilepticus – Report of the ILAE Task Force on Classification of Status Epilepticus. Epilepsia, 56(10), 1515–1523.
Updyke, M., & Duryea, B. (2013). To provoke or not to provoke: Ethical considerations in the epilepsy monitoring unit. Journal of Neuroscience Nursing, 45(3), 133–138.
U.S. Food and Drug Administration. (2014). RNS® (Responsive Neurostimulation) System P100026. Retrieved on 9/29/2016 at: www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/DeviceApprovalsandClearances/Recently-ApprovedDevices/ucm376685.htm
Van Der Naalt, J. (2015). Resting functional imaging tools (MRS, SPECT, PET, and PCT). Handbook of Clinical Neurology, 127(2015), 295–308.
Wang, X., Dong, Y., Han, X., et al. (2013). Nutritional support for patients sustaining traumatic brain injury: A systematic review and meta-analysis of prospective studies. PLoS ONE, 8(3), 1–14.
Wang, X., Ji, J., Fen, L., et al. (2013) Effects of dexmetetomidine on cerebral blood flow in critically ill patients with or without traumatic brain injury: A prospective controlled trial. Brain Injury, 27(13–14), 1617–1622.
Wells, R., Turner, D., Lee, M., et al. (2016). Managing migraine during pregnancy and lactation. Neurology and Neuroscience Reports, 16(4), 40.
Wijdicks, E. (2013). Brain death. Handbook of Clinical Neurology, 118(2013), 191–203.

Resources

American Headache Society, www.americanheadachesociety.org
Brain Injury Association of America, www.biausa.org
Brain Trauma Foundation (BTF), www.braintrauma.org
Epilepsy Foundation of America, www.epilepsy.com
Hydrocephalus Association, www.hydroassoc.org
National Headache Foundation, www.headaches.org

CHAPTER 50

Management of Patients with Cerebrovascular Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe the incidence and impact of cerebrovascular disorders.
2. Identify the risk factors for cerebrovascular disorders and related measures for prevention.
3. Compare the various types of cerebrovascular disorders: their causes, clinical manifestations, and medical management.
4. Explain the principles of nursing management as they relate to the care of a patient in the acute stage of an ischemic stroke.
5. Use the nursing process as a framework for care of a patient recovering from an ischemic stroke.
6. Apply the nursing process as a framework for care of a patient with a hemorrhagic stroke.
7. Discuss essential elements for family education and preparation for home care of the patient who has had a stroke.

GLOSSARY

agnosia: loss of ability to recognize objects through a particular sensory system; may be visual, auditory, or tactile
aneurysm: a weakening or bulge in an arterial wall
aphasia: inability to express oneself or to understand language
apraxia: inability to perform previously learned purposeful motor acts on a voluntary basis
dysarthria: defects of articulation due to neurologic causes
dysphagia: difficulty swallowing
expressive aphasia: inability to express oneself; often associated with damage to the left frontal lobe area
hemianopsia: blindness of half of the field of vision in one or both eyes
hemiparesis: weakness of one side of the body, or part of it, due to an injury in the motor area of the brain
hemiplegia: paralysis of one side of the body, or part of it, due to an injury in the motor area of the brain
infarction: tissue necrosis in an area deprived of blood supply
penumbra region: area of low cerebral blood flow
receptive aphasia: inability to understand what someone else is saying; often associated with damage to the temporal lobe area

Introduction

Cerebrovascular disorders is an umbrella term that refers to a functional abnormality of the central nervous system (CNS) that occurs when the blood supply to the brain is disrupted. Stroke is the primary cerebrovascular disorder in the United States, and while it dropped from the fourth to the fifth leading cause of death, it is still a leading cause of serious, long-term disability. Approximately 795,000 people experience a stroke each year in the United States. Approximately 610,000 of these are new strokes, and 185,000 are recurrent strokes (Mozaffarian, Benjamin, Go, et al., 2016). About 7 million people who have survived a stroke are alive today. The financial impact of stroke is profound, with estimated direct and indirect costs of $33 billion from 2011 to 2012 (Mozaffarian et al., 2016).

The incidence rate of stroke in Asia ranges between 116 and 483/100,000 per year and the prevalence of stroke among each country differs based on the age of studied population (Suwanwela & Poungvarin, 2016). In India, there is no exact data about the prevalence of stroke. The prevalence rate varies from 147 to 922/100,000 among different community-based studies (Bharucha, Bharucha, Bharucha, Bhise, & Schoenberg, 1988; Prasad, Vibha, & Meenakshi, 2012). The prevalence rate of stroke is higher in urban India (334–424/100,000) as compared to rural India (84–262/100,000). Furthermore, age-adjusted prevalence rate among women is higher (564/100,000) than men (196/100,000). Similarly, incidence rate of stroke in men is 36/100,000 and 204/100,000 in women (Pandian & Sudhan, 2013). Stroke contributed 41% of deaths and 72% of disability adjusted life years amongst the noncommunicable diseases in India (*Stroke. In: Assessment of the burden of non-communicable diseases: Final project report.*, 2004). Strokes can be divided into two major categories: ischemic (approximately 87%), in which vascular occlusion and significant hypoperfusion occur, and hemorrhagic (approximately 13%), in which there is extravasation of blood into the brain or subarachnoid space (Hickey, 2014). Although there are some similarities between the two types of stroke, differences exist in etiology, pathophysiology, medical management, surgical management, and nursing care. Table 50-1 compares ischemic and hemorrhagic strokes.

Ischemic Stroke

An ischemic stroke, formerly referred to as a cerebrovascular disease (stroke) or "brain attack," is a sudden loss of function resulting from disruption of the blood supply to a part of the brain. The term *brain attack* has been used to suggest to health care practitioners and the public that a stroke is an urgent health care issue similar to a heart attack. With the approval of thrombolytic therapy for the treatment of acute ischemic stroke in 1996 came a revolution in the care of patients after a stroke. Early treatment with thrombolytic therapy for ischemic stroke results in fewer stroke symptoms and less loss of function (National Institute of Neurological Disorders and Stroke [NINDS], 1995). The only U.S. Food and Drug Administration

TABLE 50-1 Comparison of Major Types of Stroke

Types of Stroke	Causes	Main Presenting Symptoms	Functional Recovery
Ischemic	• Large artery thrombosis • Small penetrating artery thrombosis • Cardiogenic embolic • Cryptogenic (no known cause) • Other	Numbness or weakness of the face, arm, or leg, especially on one side of the body	Usually plateaus at 6 months
Hemorrhagic	• Intracerebral hemorrhage • Subarachnoid hemorrhage • Cerebral aneurysm • Arteriovenous malformation	• "Exploding headache" • Decreased level of consciousness	Slower, usually plateaus at about 18 months

Adapted from Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

(FDA)-approved thrombolytic therapy has a treatment window of 3 hours after the onset of a stroke, and scientific statements have endorsed its expanded use for up to 4.5 hours (Del Zoppo, Saver, Jauch, et al., 2009); (Jauch, Saver, Adams, et al., 2013). Although the time frame for treatment has expanded in some centers, urgency is needed on the part of the public and health care practitioners for rapid transport of the patient to a hospital for assessment and administration of the medication.

Ischemic strokes are subdivided into five different types based on the cause: large artery thrombotic strokes (20%), small penetrating artery thrombotic strokes (25%), cardiogenic embolic strokes (20%), cryptogenic strokes (30%), and other (5%) (see Table 50-1). Large artery thrombotic strokes are caused by atherosclerotic plaques in the large blood vessels of the brain. Thrombus formation and occlusion at the site of the atherosclerosis result in ischemia and infarction (tissue necrosis in an area deprived of blood supply) (Hickey, 2014).

Small penetrating artery thrombotic strokes affect one or more vessels and are a common type of ischemic stroke. Small artery thrombotic strokes are also called *lacunar strokes* because of the cavity that is created after the death of infarcted brain tissue (Hickey, 2014).

Cardiogenic embolic strokes are associated with cardiac dysrhythmias, usually atrial fibrillation. Embolic strokes can also be associated with valvular heart disease and thrombi in the left ventricle. Emboli originate from the heart and circulate to the cerebral vasculature, most commonly the left middle cerebral artery, resulting in a stroke. Embolic strokes may be prevented by the use of anticoagulation therapy in patients with atrial fibrillation.

The last two classifications of ischemic strokes are cryptogenic strokes, which have no known cause, and strokes from other causes, such as illicit drug use (cocaine), coagulopathies, migraine/vasospasm, and spontaneous dissection of the carotid or vertebral arteries.

Pathophysiology

In an ischemic brain attack, there is disruption of the cerebral blood flow due to obstruction of a blood vessel. This disruption in blood flow initiates a complex series of cellular metabolic events referred to as the ischemic cascade (see Fig. 50-1).

The ischemic cascade begins when cerebral blood flow decreases to less than 25 mL per 100 g of blood per minute. At this point, neurons are no longer able to maintain aerobic respiration. The mitochondria must then switch to anaerobic respiration, which generates large amounts of lactic acid, causing a change in the pH. This switch to the less efficient anaerobic respiration also renders the neuron incapable of producing sufficient quantities of adenosine triphosphate (ATP) to fuel the depolarization processes. The membrane pumps that maintain electrolyte balances begin to fail, and the cells cease to function.

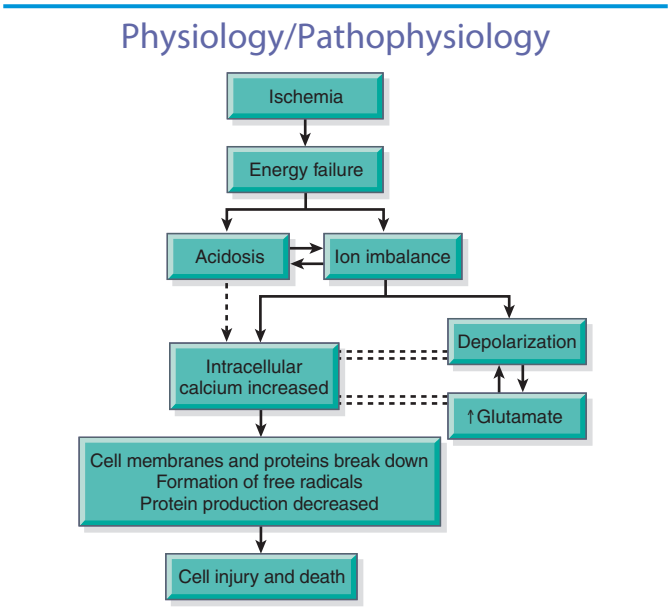


Figure 50-1 • Some of the processes contributing to ischemic brain cell injury.

Early in the cascade, an area of low cerebral blood flow, referred to as the penumbra region, exists around the area of infarction. The penumbra region is ischemic brain tissue that may be salvaged with timely intervention. The ischemic cascade threatens cells in the penumbra because membrane depolarization of the cell wall leads to an increase in intracellular calcium and the release of glutamate. The influx of calcium and the release of glutamate, if continued, activate a number of damaging pathways that result in the destruction of the cell membrane, the release of more calcium and glutamate, vasoconstriction, and the generation of free radicals. These processes enlarge the area of infarction into the penumbra, extending the stroke. A person experiencing a stroke typically loses 1.9 million neurons each minute that a stroke is not treated, and the ischemic brain ages 3.6 years each hour without treatment (Saver, 2006).

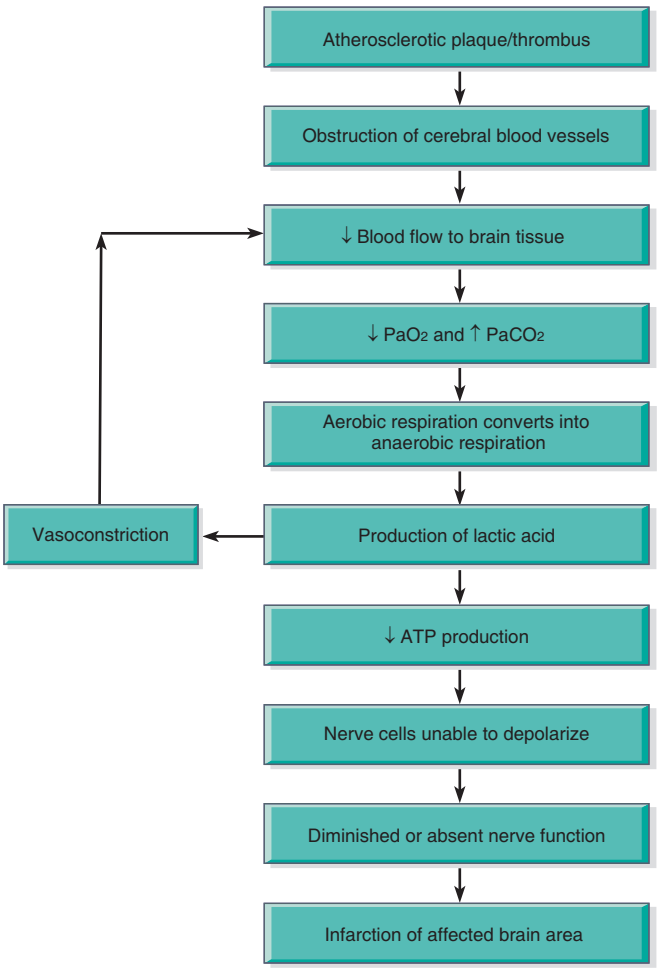


Figure 50-2 • Pathophysiology of ischemic stroke.

Each step in the ischemic cascade represents an opportunity for intervention to limit the extent of secondary brain damage caused by a stroke. The penumbra area may be revitalized by administration of tissue plasminogen activator (t-PA). Medications that protect the brain from secondary injury are called *neuroprotectants*. A number of ongoing clinical trials focus on neuroprotective medications and strategies to improve stroke recovery and survival (Jauch et al., 2013).

A flowchart for pathophysiology is presented in Figure 50.2.

Clinical Manifestations

An ischemic stroke can cause a wide variety of neurologic deficits, depending on the location of the lesion (which blood vessels are obstructed), the size of the area of inadequate perfusion, and the amount of collateral (secondary or accessory) blood flow. See Chapter 48 for discussion of anatomy and brain blood supply. The patient may present with any of the following signs or symptoms:

- Numbness or weakness of the face, arm, or leg, especially on one side of the body
- Confusion or change in mental status
- Trouble speaking or understanding speech
- Visual disturbances
- Difficulty walking, dizziness, or loss of balance or coordination
- Sudden severe headache

Motor, sensory, cranial nerve, cognitive, and other functions may be disrupted. Table 50-2 reviews the neurologic deficits frequently seen in patients with strokes. Table 50-3 compares the symptoms and behaviors seen in right hemispheric stroke with those seen in left hemispheric stroke.

Motor Loss

A stroke is an upper motor neuron lesion and results in loss of voluntary control over motor movements. Because the upper motor neurons decussate (cross), a disturbance of voluntary motor control on one side of the body may reflect damage to the upper motor neurons on the opposite side of the brain. The most common motor dysfunction is hemiplegia (paralysis of one side of the body, or part of it) caused by a lesion of the opposite side of the brain. Hemiparesis, or weakness of one side of the body, or part of it, is another sign. The concept of upper and lower motor neuron lesions is described in more detail in Chapter 48, Table 48-4.

In the early stage of stroke, the initial clinical features may be flaccid paralysis and loss of or decrease in the deep tendon reflexes. When these deep reflexes reappear (usually by 48 hours), increased tone is observed along with spasticity (abnormal increase in muscle tone) of the extremities on the affected side.

Communication Loss

Other brain functions affected by stroke are language and communication. In fact, stroke is the most common cause of aphasia (inability to express oneself or to understand language). The following are dysfunctions of language and communication:

- **Dysarthria** (difficulty in speaking) or dysphasia (impaired speech), caused by paralysis of the muscles responsible for producing speech
- **Aphasia**, which can be expressive aphasia (inability to express oneself), receptive aphasia (inability to understand language), or global (mixed) aphasia (see Chapter 48, Table 48-5)
- **Apraxia** (inability to perform a previously learned action), as may be seen when a patient makes verbal substitutions for desired syllables or words

Perceptual Disturbances

Perception is the ability to interpret sensation. Stroke can result in visual–perceptual dysfunctions, disturbances in visual–spatial relations, and sensory loss.

Visual–perceptual dysfunctions are caused by disturbances of the primary sensory pathways between the eye and visual cortex. Homonymous hemianopsia (blindness in half of the visual field in one or both eyes) may occur from stroke and may be temporary or permanent. The affected side of vision corresponds to the paralyzed side of the body.

Disturbances in visual–spatial relations (perceiving the relationship of two or more objects in spatial areas) are frequently seen in patients with right hemispheric damage.

Sensory Loss

Sensory losses from stroke may be mild, such as a slight impairment of touch, or more severe, with loss of proprioception (ability to perceive the position and motion of body parts) as well as difficulty in interpreting visual, tactile, and auditory stimuli. An agnosia is the loss of the ability to recognize objects through a particular sensory system; it may be visual, auditory, or tactile (see Chapter 48, Table 48-6).

TABLE 50-2 Neurologic Deficits of Stroke: Manifestations and Nursing Implications

Neurologic Deficit	Manifestation	Nursing Implications/Patient Education Applications
Visual Field Deficits		
Homonymous hemianopsia (loss of half of the visual field)	• Unaware of persons or objects on side of visual loss • Neglect of one side of the body • Difficulty judging distances	Place objects within intact field of vision. Approach the patient from side of intact field of vision. Instruct/remind the patient to turn head in the direction of visual loss to compensate for loss of visual field. Encourage the use of eyeglasses if available. When educating the patient, do so within patient's intact visual field.
Loss of peripheral vision	• Difficulty seeing at night • Unaware of objects or the borders of objects	Place objects in center of patient's intact visual field. Encourage the use of a cane or other object to identify objects in the periphery of the visual field. Ensure that the patient's driving ability is evaluated.
Diplopia	• Double vision	Explain to the patient the location of an object when placing it near the patient. Consistently place patient care items in the same location.
Motor Deficits		
Hemiparesis	• Weakness of the face, arm, and leg on the same side (due to a lesion in the opposite hemisphere)	Place objects within the patient's reach on the nonaffected side. Instruct the patient to exercise and increase the strength on the unaffected side.
Hemiplegia	• Paralysis of the face, arm, and leg on the same side (due to a lesion in the opposite hemisphere)	Encourage the patient to provide range-of-motion exercises to the affected side. Provide immobilization as needed to the affected side. Maintain body alignment in functional position. Exercise unaffected limb to increase mobility, strength, and use.
Ataxia	• Staggering, unsteady gait • Unable to keep feet together; needs a broad base to stand	Support patient during the initial ambulation phase. Provide supportive device for ambulation (walker, cane). Instruct the patient not to walk without assistance or supportive device.
Dysarthria	• Difficulty in forming words	Provide the patient with alternative methods of communicating. Allow the patient sufficient time to respond to verbal communication Support patient and family to alleviate frustration related to difficulty in communicating.
Dysphagia	• Difficulty in swallowing	Test the patient's pharyngeal reflexes before offering food or fluids. Assist the patient with meals. Place food on the unaffected side of the mouth. Allow ample time to eat.
Sensory Deficits		
Paresthesia (occurs on the side opposite the lesion)	• Sensation of numbness, tingling, or a "pins and needles" sensation • Difficulty with proprioception	Instruct patient that sensation may be altered. Provide range of motion to affected areas and apply corrective devices as needed.
Verbal Deficits		
Expressive aphasia	• Unable to form words that are understandable; may be able to speak in single-word responses	Encourage patient to repeat sounds of the alphabet. Explore the patient's ability to write as an alternative means of communication.
Receptive aphasia	• Unable to comprehend the spoken word; can speak but may not make sense	Speak clearly and in an unhurried manner to assist the patient in forming the sounds. Explore the patient's ability to read as an alternative means of communication.
Global (mixed) aphasia	• Combination of both receptive and expressive aphasia	Speak clearly and in simple sentences; use gestures or pictures when able Establish alternative means of communication.
Cognitive Deficits	• Short- and long-term memory loss • Decreased attention span • Impaired ability to concentrate • Poor abstract reasoning • Altered judgment	Reorient patient to time, place, and situation frequently. Use verbal and auditory cues to orient patient. Provide familiar objects (family photographs, favorite objects). Use noncomplicated language. Match visual tasks with a verbal cue; holding a toothbrush, simulate brushing of teeth while saying, "I would like you to brush your teeth now." Minimize distracting noises and views when providing education to the patient. Repeat and reinforce instructions frequently.

(Continued)

(Continued)

Emotional Deficits	• Loss of self-control • Emotional lability • Decreased tolerance to stressful situations • Depression • Withdrawal • Fear, hostility, and anger • Feelings of isolation	Support patient during uncontrollable outbursts. Discuss with the patient and family that the outbursts are due to the disease process. Encourage patient to participate in group activity. Provide stimulation for the patient. Control stressful situations, if possible. Provide a safe environment. Encourage patient to express feelings and frustrations related to disease process.

Adapted from Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

TABLE 50-3 Comparison of Left and Right Hemispheric Strokes

Left Hemispheric Stroke	Right Hemispheric Stroke
Paralysis or weakness on right side of body	Paralysis or weakness on left side of body
Right visual field deficit	Left visual field deficit
Aphasia (expressive, receptive, or global)	Spatial–perceptual deficits
Altered intellectual ability	Increased distractibility
Slow, cautious behavior	Impulsive behavior and poor judgment Lack of awareness of deficits

Adapted from Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Cognitive Impairment and Psychological Effects

If damage has occurred to the frontal lobe, learning capacity, memory, or other higher cortical intellectual functions may be impaired. Such dysfunction may be reflected in a limited attention span, difficulties in comprehension, forgetfulness, and a lack of motivation. These changes can cause the patient to become easily frustrated during rehabilitation. Depression is common and may be exaggerated by the patient's natural response to this catastrophic event. Emotional lability, hostility, frustration, resentment, lack of cooperation, and other psychological problems may occur.

Assessment and Diagnostic Findings

Any patient with neurologic deficits needs a careful history eliciting the last time the patient was seen well (Zanichkowsky, Nascimento, McCune, et al., 2016) and a rapid focused physical and neurologic examination. Initial assessment focuses on airway patency, which may be compromised by loss of gag or cough reflexes and altered respiratory pattern; cardiovascular status (including blood pressure, cardiac rhythm and rate, carotid bruit); and gross neurologic deficits.

Patients may present to the acute care facility with temporary neurologic symptoms. A transient ischemic attack (TIA) is a neurologic deficit typically lasting 1 to 2 hours. A TIA is manifested by a sudden loss of motor, sensory, or visual function. The symptoms result from temporary ischemia (impairment of blood flow) to a specific region of the brain; however, when brain imaging is performed, there is no evidence of ischemia. A TIA may serve as a warning of impending stroke. Approximately 15% of all strokes are preceded by a TIA (Miller & Summers, 2014); (Mozaffarian et al., 2016). Lack of evaluation and treatment of a patient who has experienced previous TIAs may result in a stroke and irreversible deficits.

The initial diagnostic test for a stroke is usually a noncontrast computed tomography (CT) scan (Anderson, 2016). This should be performed within 25 minutes or less from the time the patient presents to the emergency department (ED) to determine if the event is ischemic or hemorrhagic as the type of stroke determines treatment (Anderson, 2016). Further diagnostic workup for ischemic stroke involves attempting to identify the source of the thrombi or emboli. A 12-lead electrocardiogram (ECG) and a carotid ultrasound are standard tests. Other studies may include CT angiography or CT perfusion; magnetic resonance imaging (MRI) and magnetic resonance angiography of the brain and neck vessels; transcranial Doppler flow studies; transthoracic or transesophageal echocardiography; xenon-enhanced CT scan; and single-photon emission CT scan (Summers, Leonard, Wentworth, et al., 2009); (Jauch et al., 2013); (Miller & Summers, 2014).

Prevention

Primary prevention of ischemic stroke remains the best approach. A healthy lifestyle including not smoking, engaging in physical activity (at least 40 minutes a day, 3 to 4 days a week), maintaining a healthy weight, and following a healthy diet (including modest alcohol consumption), can reduce the risk of having a stroke (Mozaffarian et al., 2016). Specific diets that have decreased risk of stroke include the Dietary Approaches to Stop Hypertension (DASH) diet (high in fruits and vegetables, moderate in low-fat dairy products, and low in animal protein), the Mediterranean diet (supplemented with nuts), and overall diets that are rich in fruits and vegetables. Research findings suggest that low-dose aspirin may lower the risk of a first stroke for those who are at risk (Meschia, Bushnell, Boden-Albala, et al., 2014).

Stroke risk screenings are an ideal opportunity to lower stroke risk by identifying people or groups of people who are at high risk for stroke and by educating patients and the community about recognition and prevention of stroke. Stroke screenings are usually coordinated and run by nurses. Age, gender, and race are well-known nonmodifiable risk factors for stroke. High-risk groups include people older than 55 years, and the incidence of stroke more than doubles in each successive decade. Men have a higher age-adjusted rate of stroke than that of women. However, the magnitude of strokes in women should not be underplayed; 1 in 6 women die of stroke as compared to 1 in 25 who die of breast cancer (Ennen, 2013), and each year 55,000 more women than men have a stroke (Mozaffarian et al., 2016). Compared to Caucasian Americans, African Americans and some Hispanic/Latino Americans have a higher incidence of stroke and higher mortality (Meschia et al., 2014); (Aycock & Clark, 2016). The Nursing Research Profile in Chart 50-1 examines the accuracy of perceived stroke risk in African Americans (Aycock & Clark, 2016).

There are many risk factors for ischemic stroke (see Chart 50-2). For people who are at high risk, interventions that alter modifiable factors, such as treating hypertension and stopping smoking, reduce stroke risk.

Chart 50-1 NURSING RESEARCH PROFILE

Awareness of Stroke Risk in Young African Americans

Aycock, D. M., & Clark, P. C. (2016). Incongruence between perceived long-term risk and actual risk of stroke in rural African Americans. Journal of Neuroscience Nursing, 48(1), 35–41.

Purpose

African Americans aged 20 to 44 years are twice as likely to have a stroke as Caucasians of the same age. African Americans aged 35 to 64 years also have a higher risk (three to four times) of dying from a stroke than Caucasians. When a stroke occurs in a younger adult, they live longer with disabilities with greater health care costs and loss of productivity. Because up to 80% of strokes can be prevented with recognition and elimination of risk factors, primary prevention is critically important. The purpose of this study was to examine the accuracy of perceived stroke risk of African Americans aged 19 to 54 years.

Design

This study used a descriptive-correlational design. Participants consisted of a nonrandom sample that was recruited from a mobile health clinic (traveling to four rural counties over 4 months). Participants self-identified as African American, were between 19 and 54 years of age, were current residents of a rural county, and could not have a physical impairment that could keep them from exercising. Sixty-six participants were enrolled in the study. Participants were asked to select the risk that represented their risk of having a stroke in the next 10 to 20 years (no risk, little risk, moderate risk, or high risk). This was compared to an individual actual risk assessment that was based on accepted risk factors for stroke. The form that was used included health, social and family histories, and biophysiologic health measures (blood pressure and glucose). A scoring system was used as a guide to obtain a risk factor score. Scores could range between 0 and 8 (zero would be no risk factors). The measures were compared and participants were placed into risk accuracy categories: accurate, underestimate, or overestimate.

Findings

The mean age of participants was 43.3 years. Most of the participants were female (71%). Comparisons of the scores showed that 44% underestimated their risk, 47% were accurate, and 9% overestimated their risk. 67% of participants with a family history of stroke and 69% with a history of hypertension did not identify these as risk factors. Eighty percent of those who smoked cigarettes, 93% of those with diabetes, and 88% of those who were either overweight or who had obesity did not identify these as risk factors. This sample had a high burden of risk factors for stroke. Of the 39 participants who had 3 or more risk factors, only 19 (49%) thought that they were moderate to high risk of stroke.

Nursing Implications

This study suggests that more public education about primary prevention and awareness of modifiable stroke risk factors is needed. Nurses are in an optimal position to provide this education. Nurses in all settings (hospital, community, rehabilitation, outpatient clinics, and industry) should be involved in prevention and wellness activities for the public. This study focused on a young to middle-aged African American sample. Awareness campaigns can be focused and individualized for a younger population, and this study indicates that this type of campaign is needed. More studies are needed to test educational materials and tools that can be of benefit to this young to middle-aged population.

Chart 50-2 MODIFIABLE RISK FACTORS

Ischemic Stroke

- Asymptomatic carotid stenosis
- Atrial fibrillation
- Diabetes (associated with accelerated atherogenesis)
- Dyslipidemia
- Excessive alcohol consumption
- Hypercoagulable states
- Hypertension (controlling hypertension, the major risk factor, is the key to preventing stroke)
- Migraine
- Obesity
- Sedentary lifestyle
- Sleep apnea
- Smoking

Adapted from Meschia, J. F., Bushnell, C., Boden-Albala, B., et al. (2014). Guidelines for the primary prevention of stroke: A statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 45(12), 3754–3832.

Additional treatable conditions that increase risk of stroke include sickle cell diseases, cardiomyopathy (ischemic and nonischemic), and valvular heart disease (e.g., endocarditis, prosthetic heart valves). Lesser known and potentially modifiable risk factors for stroke are migraine (especially migraine with aura), sleep apnea, and inherited and acquired hypercoagulable states. Chronic inflammatory conditions that have been associated with an increased risk of stroke are systemic lupus erythematosus and rheumatoid arthritis (Meschia et al., 2014).

Several methods of preventing recurrent stroke have been identified for patients with TIAs or ischemic stroke. Patients with moderate to severe carotid stenosis are treated with carotid endarterectomy (CEA) or carotid angioplasty and stenting. In patients with atrial fibrillation, which increases the risk of emboli, administration of an anticoagulant that inhibits clot formation may prevent both thrombotic and embolic strokes (Kernan, Ovbiagele, Black, et al., 2014).

Medical Management

Patients who have experienced a TIA or stroke should have medical management for secondary prevention. Those with atrial fibrillation (or cardioembolic strokes) are treated with dose-adjusted warfarin (Coumadin) with a target international normalized ratio (INR) of 2 to 3. Other newer anticoagulants that may be prescribed as alternative drugs include dabigatran (Pradaxa), apixaban (Eliquis), edoxaban (Savaysa), or rivaroxaban (Xarelto), unless they are contraindicated. These newer drugs are also known as new or novel oral anticoagulants (NOACs) (Bentz, 2015). If anticoagulants are contraindicated, aspirin alone is the best option, although the addition of clopidogrel (Plavix) to aspirin is also a reasonable therapy (Kernan et al., 2014).

Platelet-inhibiting medications, including aspirin, extended-release dipyridamole plus aspirin (Aggrenox), and clopidogrel decrease the incidence of cerebral infarction in patients who have experienced TIAs and stroke from suspected embolic or thrombotic causes. The specific medication that is used is based on the patient's health history.

Research suggests that medications known as statins reduce coronary events and ischemic strokes. The most current stroke prevention guideline now includes the recommendation of a statin even if the low-density lipoprotein (LDL) cholesterol is below 100 mg/dL and there is no evidence of atherosclerotic cardiovascular disease (coronary artery disease/myocardial infarction, hypertensive heart disease and peripheral arterial disease) (Kernan et al., 2014). The FDA has included indications for statin medications, such as simvastatin (Zocor), to include secondary stroke prevention.

After the acute stroke period, antihypertensive medications are also used, if indicated, for secondary stroke prevention. Preferred drugs include angiotensin-converting enzyme (ACE) inhibitors and diuretics, or a combination of both (Kernan et al., 2014).

Medical management of acute ischemic stroke needs to include consideration for endovascular treatment (Powers, Derdeyn, Biller, et al., 2015). The FDA has approved several devices that open the blocked artery and restore blood flow to the brain. These devices are used by specialists in the endovascular suite.

Thrombolytic Therapy

Thrombolytic agents are used to treat ischemic stroke by dissolving the blood clot that is blocking blood flow to the brain. Recombinant t-PA is a genetically engineered form of t-PA (a thrombolytic substance made naturally by the body) (Karch, 2014). It works by binding to fibrin and converting plasminogen to plasmin, which stimulates fibrinolysis of the clot. Rapid diagnosis of stroke and initiation of thrombolytic therapy (within 3 hours) in patients with ischemic stroke leads to a decrease in the size of the stroke and an overall improvement in functional outcome after 3 months (NINDS, 1995). The goal is for intravenous (IV) t-PA to be given within 60 minutes of the patient arriving to the ED (Jauch et al., 2013).

Intra-arterial delivery of t-PA is an alternative to IV administration. This type of administration can allow for higher concentrations of the drug to be given directly to the clot, and the time window for treatment may be extended up to 6 hours. Those not eligible for IV delivery may be eligible for intra-arterial delivery, and these methods may also be combined. Treatment using intra-arterial delivery must occur in specialized centers with access to emergent cerebral angiogram and interventional operating rooms/suites (Summers et al., 2009); (Jauch et al., 2013). Ongoing clinical trials continue to investigate the efficacy of other thrombolytic agents.

To realize the full potential of early intervention, community education directed at recognizing the symptoms of stroke and obtaining appropriate emergency care is necessary to ensure rapid transport to a hospital and initiation of therapy within the recommended 3-hour period (which may be extended up to 4.5 hours in some cases) (Del Zoppo et al., 2009). Delays make the patient ineligible for therapies, because revascularization of necrotic tissue (which develops after 3 hours) increases the risk of cerebral edema and hemorrhage.

Endovascular Therapy

It is now recommended that patients with acute ischemic stroke receive endovascular therapy and medical management with a stent retriever if they meet specific criteria (Powers et al., 2015). All of the following criteria need to be met:

- Prestroke status of no deficits
- Acute ischemic stroke receiving IV t-PA within 4.5 hours of onset according to guidelines from professional medical societies
- Causative occlusion of the internal carotid artery or proximal middle cerebral artery
- Age ≥18 years
- NIHSS score of ≥6
- ASPECT (a radiologic assessment of the CT scan) score of ≥6, and treatment can be initiated (groin puncture) within 6 hours of symptom onset

Patients eligible for t-PA should receive IV t-PA even if endovascular treatments are being considered (Powers et al., 2015). Thrombolytic therapy should not be delayed.

Enhancing Prompt Diagnosis

After being notified by emergency medical service personnel, the ED contacts the appropriate staff (neurologist, neuroradiologist, radiology department, nursing staff, ECG, and laboratory technicians) and informs them of the patient's imminent arrival at the hospital. Many institutions have acute stroke teams that respond rapidly, ensuring that treatment occurs within the allotted period. This may be called a Code Stroke.

Initial management requires the definitive diagnosis of an ischemic stroke by brain imaging and a careful history to determine whether the patient meets the criteria for t-PA therapy (see Chart 50-3). The goal is that diagnostic results from imaging are completed within 25 minutes of the patient's arrival to the ED (Middleton, Grimley, & Alexandrov, 2015). Some of the contraindications for thrombolytic therapy include symptom onset greater than 3 hours before admission (expanded to 4.5 hours in some cases), a patient who is anticoagulated (with an INR above 1.7), or a patient who has recently had any type of significant intracranial pathology (e.g., previous stroke, head injury, trauma) in the last 3 months.

Chart 50-3

Eligibility Criteria for Tissue Plasminogen Activator Administration

- Age ≥18 years
- Clinical diagnosis of ischemic stroke
- Time of onset of stroke known and is less than 3 hours before treatment
- Systolic blood pressure ≤185 mm Hg; diastolic ≤110 mm Hg
- No minor stroke or rapidly resolving stroke
- No seizure at onset of stroke
- Prothrombin time ≤15 seconds or international normalized ratio ≤1.7 (if taking an anticoagulant, the same guidance is used)
- Not received heparin during the past 48 hours with elevated partial thromboplastin time
- Platelet count ≥100,000/mm3
- Glucose >50 mg/dL
- No prior intracranial hemorrhage, neoplasm, arteriovenous malformation, or aneurysm
- No major surgical procedures or serious trauma within 14 days
- No stroke, serious head injury, or intracranial surgery within 3 months
- No gastrointestinal or urinary bleeding within 21 days
- No pregnancy

Some of these are relative contraindications (the provider administering the medication needs to weigh the risks and benefits of the therapy). There are more stringent criteria if t-PA is considered for those patients in the 3.0- to 4.5-hour time window.

Adapted from Jauch, E. C., Saver, J. L., Adams, H. P., et al. (2013). Guidelines for the early management of patients with ischemic stroke: A guideline from the American Heart Association/American Stroke Association. Stroke, 44(1), 870–947.

Before receiving t-PA, the patient is assessed using the National Institutes of Health Stroke Scale (NIHSS), a standardized assessment tool that helps evaluate stroke severity (see Table 50-4). Total NIHSS scores range from 0 (normal) to 42 (severe stroke). Certification in the administration of the scale is recommended and is available for nurses and other health care professionals.

Dosage and Administration

The patient is weighed to determine the dose of t-PA. Typically, two or more IV sites are established prior to administration of t-PA (one for the t-PA and the other for administration of IV fluids). The dosage for t-PA is 0.9 mg/kg, with a maximum dose of 90 mg. Ten percent of the calculated dose is given as an IV bolus over 1 minute. The remaining dose (90%) is given IV over 1 hour via an infusion pump (Jauch et al., 2013).

The patient is admitted to the intensive care unit or an acute stroke unit, where continuous cardiac monitoring and frequent neurologic assessments are conducted. Vital signs are obtained frequently, with particular attention to blood pressure (with the goal of lowering the risk of intracranial hemorrhage). An example of a standard protocol would be to obtain vital signs every 15 minutes for the first 2 hours, every 30 minutes for the next 6 hours, then

TABLE 50-4 Summary of National Institutes of Health Stroke Scale

Category	Description	Score
1a. LOC	Alert	0
	Arousable by minor stimulation	1
	Obtunded, strong stimulation to attend	2
	Unresponsive, or reflexive responses only	3
1b. LOC questions (month, age)	Answers both correctly	0
	Answers one correctly	1
	Both incorrect	2
1c. LOC commands (open, close eyes; make fist, let go)	Obeys both correctly	0
	Obeys one correctly	1
	Both incorrect	2
2. Best gaze (eyes open—patient follows examiner's finger or face)	Normal	0
	Partial gaze palsy	1
	Forced deviation	2
3. Visual (introduce visual stimulus/threat to patient's visual field quadrants)	No visual loss	0
	Partial hemianopsia	1
	Complete hemianopsia	2
	Bilateral hemianopsia	3
4. Facial palsy (show teeth, raise eyebrows, and squeeze eyes shut)	Normal	0
	Minor	1
	Partial	2
	Complete	3
5a. Motor; arm—left (elevate extremity to 90 degrees and score drift/movement)	No drift	0
	Drift but maintains in air	1
	Unable to maintain in air	2
	No effort against gravity	3
	No movement	4
	Amputation, joint fusion (explain)	N/A
5b. Motor; arm—right (elevate extremity to 90 degrees and score drift/movement)	No drift	0
	Drift but maintains in air	1
	Unable to maintain in air	2
	No effort against gravity	3
	No movement	4
	Amputation, joint fusion (explain)	N/A
6a. Motor; leg—left (elevate extremity to 30 degrees and score drift/movement)	No drift	0
	Drift but maintains in air	1
	Unable to maintain in air	2
	No effort against gravity	3
	No movement	4
	Amputation, joint fusion (explain)	N/A

(Continued)

(Continued)

6b. Motor; leg—right (elevate extremity to 30 degrees and score drift/movement)	No drift	0
	Drift but maintains in air	1
	Unable to maintain in air	2
	No effort against gravity	3
	No movement	4
	Amputation, joint fusion (explain)	N/A
7. Limb ataxia (finger-to-nose and heel-to-shin testing)	Absent	0
	Present in one limb	1
	Present in two limbs	2
8. Sensory (pinprick to face, arm, trunk, and leg—compare side to side)	Normal	0
	Mild to moderate loss	1
	Severe to total loss	2
9. Best language (name items, describe a picture, and read sentences)	No aphasia	0
	Mild to moderate aphasia	1
	Severe aphasia	2
	Mute	3
10. Dysarthria (evaluate speech clarity by having patient repeat words)	Normal	0
	Mild to moderate dysarthria	1
	Severe dysarthria, mostly unintelligible or worse	2
	Intubated or other physical barrier	N/A
11. Extinction and inattention (use information from prior testing to score)	No abnormality	0
	Visual, tactile, auditory, or other extinction to bilateral simultaneous stimulation	1
	Profound hemiattention or extinction to more than one modality	2
Total score		___

LOC, level of consciousness; N/A, not applicable.

Adapted from the version available at the National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD 20892. Retrieved on 4/23/17 at: www.ninds.nih.gov/sites/default/files/NIH_Stroke_Scale_Booklet.pdf. It is recommended that the full scale with all instructions be used.

every hour until 24 hours after treatment. Blood pressure should be maintained with the systolic pressure less than 180 mm Hg and the diastolic pressure less than 105 mm Hg (Jauch et al., 2013); (Middleton et al., 2015). Airway management is instituted based on the patient's clinical condition and arterial blood gas values.

Side Effects

Once it is determined that the patient is a candidate for t-PA therapy, no anticoagulant agents are given for the next 24 hours. Bleeding is the most common side effect of t-PA administration, and the patient is closely monitored for any bleeding (IV insertion sites, urinary catheter site, endotracheal tube, nasogastric tube, urine, stool, emesis, other secretions). A 24-hour delay in placement of nasogastric tubes, urinary catheters, and intra-arterial pressure catheters is recommended. Intracranial bleeding is a major complication that occurred in approximately 6.4% of patients in the initial t-PA study (NINDS, 1995). A number of factors are associated with the occurrence of symptomatic intracranial bleeding: age greater than 70 years, baseline NIHSS score greater than 20, serum glucose concentration 300 mg/dL or higher, and edema or mass effect observed on the patient's initial CT scan (NINDS, 1995).

Therapy for Patients With Ischemic Stroke Not Receiving Tissue Plasminogen Activator

Not all patients are candidates for t-PA therapy. In some centers, other treatments may include anticoagulant administration (IV heparin or low–molecular-weight heparin). Because of the risks associated with anticoagulation, their general use is no longer recommended for patients with acute ischemic stroke (Jauch et al., 2013).

Careful maintenance of cerebral hemodynamics to maintain cerebral perfusion is extremely important after a stroke. Increased intracranial pressure (ICP) from brain edema and associated complications may occur after a large ischemic stroke. Interventions during this period include measures to reduce ICP, such as administering an osmotic diuretic (e.g., mannitol) to those that are declining clinically (Wijdicks, Sheth, Carter, et al., 2014). Other treatment measures include the following:

- Providing supplemental oxygen if oxygen saturation is below 95%
- Elevation of the head of the bed to 30 degrees to assist the patient in handling oral secretions and decrease ICP
- Possible hemicraniectomy for increased ICP from brain edema in a very large stroke
- Intubation with an endotracheal tube to establish a patent airway, if necessary
- Continuous hemodynamic monitoring (the goals for blood pressure remain controversial for a patient who has not received thrombolytic therapy; antihypertensive treatment may be withheld unless the systolic blood pressure exceeds 220 mm Hg or the diastolic blood pressure exceeds 120 mm Hg.)
- Frequent neurologic assessments to determine if the stroke is evolving and if other acute complications are developing

(such complications may include seizures, bleeding from anticoagulation, or medication-induced bradycardia, which can result in hypotension and subsequent decreases in cardiac output and cerebral perfusion pressure).

Managing Potential Complications

Adequate cerebral blood flow is essential for cerebral oxygenation. If cerebral blood flow is inadequate, the amount of oxygen supplied to the brain will decrease, and tissue ischemia will result. Adequate oxygenation begins with pulmonary care, maintenance of a patent airway, and administration of supplemental oxygen as needed. The importance of adequate gas exchange in these patients cannot be overemphasized, because many patients are at risk for aspiration pneumonia.

Other potential complications after a stroke include urinary tract infections, cardiac dysrhythmias (ventricular ectopy, tachycardia, and heart blocks), and complications of immobility. Hyperglycemia has been associated with poor neurologic outcomes in acute stroke, therefore blood glucose should be in the range of 140 to 180 mg/dL, and hypoglycemia should be avoided (Jauch et al., 2013).

Surgical Prevention of Ischemic Stroke

The main surgical procedure for selected patients with TIAs and mild stroke is CEA, which currently is the most frequently performed noncardiac vascular procedure. A CEA is the removal of an atherosclerotic plaque or thrombus from the carotid artery to prevent stroke in patients with occlusive disease of the extracranial cerebral arteries (see Fig. 50-3). This surgery is indicated for patients with symptoms of TIA or mild stroke (or those without symptoms) that are found to have severe (70% to 99%) carotid artery stenosis or moderate (50% to 69%) stenosis with other significant risk factors.

Carotid artery stenting (CAS), with or without angioplasty, is a less invasive procedure that is used for treatment of carotid stenosis. This procedure has less discomfort for the patient and a shorter recovery time than CEA. Age can be considered when deciding which procedure will be best for the patient. For older patients (older than 70 years), CEA demonstrated improved outcomes in research studies; for those who were younger, outcomes between CAS and CEA were similar when comparing procedure complications (Kernan et al., 2014).

Nursing Management

The main complications of CEA are stroke, cranial nerve injuries, infection or hematoma at the incision, and carotid artery disruption. It is important to maintain adequate blood pressure levels in the immediate postoperative period. Hypotension is avoided to prevent cerebral ischemia and thrombosis. Uncontrolled hypertension may precipitate cerebral hemorrhage, edema, hemorrhage at the surgical incision, or disruption of the arterial reconstruction. Medications are used to reduce the blood pressure to previous levels. Close cardiac monitoring is necessary, because these patients frequently have concomitant coronary artery disease.

After CEA, a neurologic observation record (see Chapter 49, Fig. 49-8) is used to monitor and document assessment parameters for all body systems, with particular attention to neurologic status. The surgeon is notified immediately if a neurologic deficit develops. Formation of a thrombus at the site of the endarterectomy is suspected if there is a sudden new onset of neurologic deficits, such as weakness on one side of the body. The patient should be prepared for repeat endarterectomy.

Difficulty in swallowing, hoarseness, or other signs of cranial nerve dysfunction must be assessed. The nurse focuses on assessment of the following cranial nerves: facial (VII), vagus (X), spinal accessory (XI), and hypoglossal (XII). Some edema in the neck after surgery is expected; however, extensive edema and hematoma formation can obstruct the airway. Emergency airway supplies, including those needed for a tracheostomy, must be available. Table 50-5 provides more information about potential complications of carotid surgery.

Management after carotid stenting also requires monitoring of neurologic status and evaluation for hematoma formation (at the catheterization site). Cardiac monitoring is necessary with assessment for bilateral pulses distal to the catheterization site. Typically, patients are discharged the day after stenting if there are no complications (Treat-Jacobson, Rich, DeVeaux, et al., 2013).

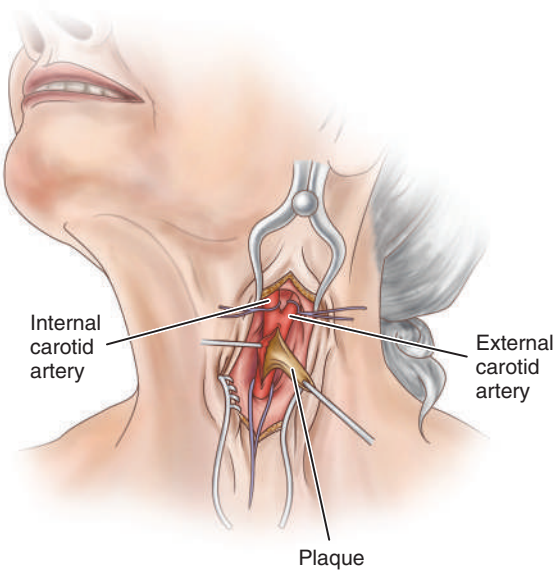


Figure 50-3 • Plaque, a potential source of emboli in transient ischemic attack and stroke, is surgically removed from the carotid artery.

TABLE 50-5 Selected Complications of Carotid Endarterectomy (CEA) and Nursing Interventions

Complication	Characteristics	Nursing Interventions
Incision hematoma	Occurs in 5.5% of patients. Large or rapidly expanding hematomas require emergency treatment. If the airway is obstructed by the hematoma, the incision may be opened at the bedside.	Monitor neck discomfort and wound expansion Report swelling, subjective feelings of pressure in the neck, difficulty breathing.
Hypertension	Poorly controlled hypertension increases the risk of postoperative complications, including hematoma and hyperperfusion syndrome. There is an increased incidence of neurologic impairment and death due to intracerebral hemorrhage. May be related to surgically induced abnormalities of carotid baroreceptor sensitivity.	Keep in mind that risk is highest in the first 48 hours after surgery. Check blood pressure frequently, and report deviations from baseline Administer medications, as prescribed, to reduce hypertension. Observe for and report new onset of neurologic deficits.
Postoperative hypotension	Occurs in approximately 5% of patients. Treated with fluids and low-dose phenylephrine infusion. Usually resolves in 24–48 hours. Patients with hypotension should have serial electrocardiograms to rule out myocardial infarction.	Monitor blood pressure, and observe for signs and symptoms of hypotension.
Hyperperfusion syndrome	Occurs when cerebral vessel autoregulation fails. Arteries accustomed to diminished blood flow may be permanently dilated; increased blood flow after endarterectomy coupled with insufficient vasoconstriction leads to capillary bed damage, edema, and hemorrhage.	Observe for severe unilateral headache improved by sitting upright or standing.
Intracerebral hemorrhage	Occurs infrequently but is often fatal (60%) or results in serious neurologic impairment. Can occur secondary to hyperperfusion syndrome. Increased risk with advanced age, hypertension, presence of high-grade stenosis, poor collateral flow, and slow flow in the region of the middle cerebral artery.	Monitor neurologic status, and report any changes in mental status or neurologic functioning immediately.

NURSING PROCESS

The Patient Recovering from an Ischemic Stroke

The acute phase of an ischemic stroke may last 1 to 3 days, but ongoing monitoring of all body systems is essential as long as the patient requires care. The patient who has had a stroke is at risk for multiple complications, including deconditioning and other musculoskeletal problems, swallowing difficulties, bowel and bladder dysfunction, inability to perform self-care, and skin breakdown. Nursing management focuses on the prompt initiation of rehabilitation for any deficits.

Assessment

During the acute phase, a neurologic flow sheet is maintained to provide data about the following important measures of the patient's clinical status:

- Change in level of consciousness or responsiveness as evidenced by movement, resistance to changes of position, and response to stimulation; orientation to time, place, and person
- Presence or absence of voluntary or involuntary movements of the extremities, muscle tone and strength, body posture, and position of the head
- Eye opening, comparative size of pupils and pupillary reactions to light, and ocular position
- Color of the face and extremities; temperature and moisture of the skin
- Quality and rates of pulse and respiration; arterial blood gas values as indicated, body temperature, and arterial pressure
- Ability to speak
- Volume of fluids ingested or given; volume of urine excreted each 24 hours
- Presence of bleeding
- Maintenance of blood pressure within the desired parameters
- Monitoring of continuous oxygen saturation

After the acute phase, the nurse assesses mental status (memory, attention span, perception, orientation, affect, speech/language), sensation/perception (the patient may have decreased awareness of pain and temperature), motor control (upper and lower extremity movement), swallowing ability, nutritional and hydration status, skin integrity, activity tolerance, and bowel and bladder function. Ongoing nursing assessment continues to focus on any impairment of function in the patient's daily activities, because the quality of life after stroke is closely related to the patient's functional status.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Impaired physical mobility related to hemiparesis, loss of balance and coordination, spasticity, and brain injury
- Acute pain (painful shoulder) related to hemiplegia and disuse
- Self-care deficits (bathing, hygiene, toileting, dressing, and feeding) related to stroke sequelae
- Impaired comfort related to altered sensory reception, transmission, and/or integration
- Impaired swallowing
- Impaired urinary elimination related to flaccid bladder, detrusor instability, confusion, or difficulty in communicating
- Constipation related to change in mental status or difficulty communicating
- Acute confusion related to brain infarction
- Impaired verbal communication related to brain damage
- Risk for impaired skin integrity related to hemiparesis, hemiplegia, or decreased mobility
- Interrupted family processes related to catastrophic illness and caregiving burdens
- Sexual dysfunction related to neurologic deficits or fear of failure

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Decreased cerebral blood flow due to increased ICP
- Inadequate oxygen delivery to the brain
- Pneumonia

Planning and Goals

Although rehabilitation begins on the day the patient has the stroke, the process is intensified during convalescence and requires a coordinated team effort. It is helpful for the team to know what the patient was like before the stroke: their illnesses, abilities, mental and emotional state, behavioral characteristics, and activities of daily living. It is also helpful for clinicians to be knowledgeable about the relative importance of predictors of stroke outcome (age, NIHSS score, and level of consciousness at the time of admission) in order to provide survivors of stroke and their families with realistic goals (Jauch et al., 2013).

The major goals for the patient (and family) may include improved mobility, avoidance of shoulder pain, achievement of self-care, relief of discomfort, prevention of aspiration, continence of bowel and bladder, decreasing confusion, achieving a form of communication, maintaining skin integrity, restored family functioning, improved sexual function, and absence of complications.

Nursing Interventions

Nursing care has a significant impact on the patient's recovery. Often, many body systems are impaired as a result of the stroke, and conscientious care and timely interventions can prevent debilitating complications. During and after the acute phase, nursing interventions focus on the whole person. In addition to providing physical care, the nurse encourages and fosters recovery by listening to the patient and asking questions to elicit the meaning of the stroke experience.

Improving Mobility and Preventing Joint Deformities

A patient with hemiplegia has unilateral paralysis (paralysis on one side). When control of the voluntary muscles is lost, the strong flexor muscles exert control over the extensors. The arm tends to adduct (adductor muscles are stronger than abductors) and to rotate internally. The elbow and the wrist tend to flex, the affected leg tends to rotate externally at the hip joint and flex at the knee, and the foot at the ankle joint supinates and tends toward plantar flexion.

Correct positioning is important to prevent contractures; measures are used to relieve pressure, assist in maintaining good body alignment, and prevent compressive neuropathies, especially of the ulnar and peroneal nerves. Because flexor muscles are stronger than extensor muscles, a splint applied at night to the affected extremity may prevent flexion and maintain correct positioning during sleep (see Chapter 38).

Preventing Shoulder Adduction. To prevent adduction of the affected shoulder while the patient is in bed, a pillow is placed in the axilla when there is limited external rotation; this keeps the arm away from the chest. A pillow is placed under the arm, and the arm is placed in a neutral (slightly flexed) position, with distal joints positioned higher than the more proximal joints (i.e., the elbow is positioned higher than the shoulder and the wrist higher than the elbow). This helps to prevent edema and the resultant joint fibrosis that will limit range of motion if the patient regains control of the arm (see Fig. 50-4).

Positioning the Hand and Fingers. The fingers are positioned so that they are barely flexed. The hand is placed in slight supination (palm faces upward), which is its most functional position. If the upper extremity is flaccid, a splint can be used to support the wrist and hand in a functional position. If the upper extremity is spastic, a hand roll is not used, because it stimulates the grasp reflex. In this instance, a dorsal wrist splint is useful in allowing the palm to be free of pressure. Every effort is made to prevent hand edema.



Figure 50-4 • Correct positioning to prevent shoulder adduction.

Spasticity, particularly in the hand, can be a disabling complication after stroke. Botulinum toxin type A injected intramuscularly into wrist and finger muscles has been shown to be effective in reducing this spasticity (although the effect is temporary, typically lasting 2 to 4 months) (Teasell, Foley, Pereira, et al., 2012). Other treatments for spasticity may include stretching, splinting, and oral medications such as baclofen (Lioresal), diazepam (Valium), dantrolene (Dantrium), and tizanidine (Zanaflex).

Changing Positions. The patient's position should be changed every 2 hours. To place a patient in a lateral (side-lying) position, a pillow is placed between the legs before the patient is turned. To promote venous return and prevent edema, the upper thigh should not be acutely flexed. The patient may be turned from side to side, but if sensation is impaired, the amount of time spent on the affected side should be limited.

If possible, the patient is placed in a prone position for 15 to 30 minutes several times a day. A small pillow or a support is placed under the pelvis, extending from the level of the umbilicus to the upper third of the thigh (see Fig. 50-5). This position helps promote hyperextension of the hip joints, which is essential for normal gait and helps prevent knee and hip flexion contractures. The prone position also helps drain bronchial secretions and prevents contractural deformities of the shoulders and knees. During positioning, it is important to reduce pressure and change position frequently to prevent pressure ulcers.

Establishing an Exercise Program. The affected extremities are exercised passively and put through a full range of motion four or five times a day to maintain joint mobility, regain motor control, prevent contractures in the paralyzed extremity, prevent further deterioration of the neuromuscular system,

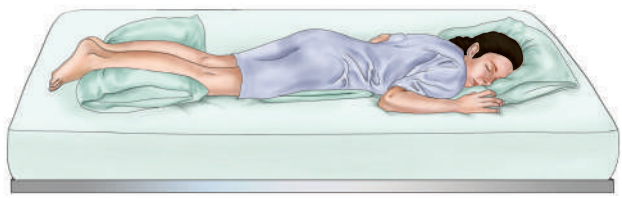


Figure 50-5 • Prone position with pillow support helps prevent hip flexion.

and enhance circulation. Exercise is helpful in preventing venous stasis, which may predispose the patient to venous thromboembolism (VTE). VTE includes deep vein thrombosis (DVT) and pulmonary embolus (PE).

Repetition of an activity forms new pathways in the CNS and therefore encourages new patterns of motion. At first, the extremities are usually flaccid. If tightness occurs in any area, the range-of-motion exercises should be performed more frequently (see Chapter 38).

The patient is observed for signs and symptoms that may indicate PE or excessive cardiac workload during exercise; these include shortness of breath, chest pain, cyanosis, and increasing pulse rate with exercise. Frequent short periods of exercise always are preferable to longer periods at infrequent intervals. Regularity in exercise is most important. Improvement in muscle strength and maintenance of range of motion can be achieved only through daily exercise.

The patient is encouraged and reminded to exercise the unaffected side at intervals throughout the day. It is helpful to develop a written schedule to remind the patient of the exercise activities. The nurse supervises and supports the patient during these activities. The patient can be instructed to put the unaffected leg under the affected one to assist in moving it when turning and exercising. Flexibility, strengthening, coordination, endurance, and balancing exercises prepare the patient for ambulation. Quadriceps muscle setting and gluteal setting exercises (see Chapter 36, Chart 36-1) are started early to improve the muscle strength needed for walking; these are performed at least five times daily for 10 minutes at a time.

Preparing for Ambulation. As soon as possible, the patient is assisted out of bed and an active rehabilitation program is started. The patient is first educated to maintain balance while sitting and then to learn to balance while standing. If the patient has difficulty in achieving standing balance, a tilt table, which slowly brings the patient to an upright position, can be used. Tilt tables are especially helpful for patients who have been on bed rest for prolonged periods and have orthostatic blood pressure changes.

If the patient needs a wheelchair, the folding type with hand brakes is the most practical because it allows the patient to manipulate the chair. The chair should be low enough to allow the patient to propel it with the uninvolved foot and narrow enough to permit it to be used at home. When the patient is transferred from the wheelchair, the brakes must be applied and locked on both sides of the chair.

The patient is usually ready to walk as soon as standing balance is achieved. Parallel bars are useful in these first efforts. A chair or wheelchair should be readily available in case the patient suddenly becomes fatigued or feels dizzy.

The training periods for ambulation should be short and frequent. As the patient gains strength and confidence, an adjustable cane can be used for support. In general, a three- or four-pronged cane provides a stable support in the early phases of rehabilitation.

Preventing Shoulder Pain

The incidence of shoulder pain after stroke can vary widely, but has been measured to be as high as 84% (Zheng & Alexander, 2015). That pain may prevent patients from learning new skills and affect their quality of life. Shoulder function is essential in achieving balance and performing transfers and self-care activities. Problems that can occur include rotator cuff disorders, spasticity of the shoulder muscles, painful shoulder, subluxation of the shoulder, and shoulder–hand syndrome. Development of a condition known as central pain syndrome may also contribute to the development of shoulder pain after a stroke.

A flaccid shoulder joint may be overstretched by the use of excessive force in turning the patient or from overstrenuous arm and shoulder movement. To prevent shoulder pain, the nurse should never lift the patient by the flaccid shoulder or pull on the affected arm or shoulder. Overhead pulleys should also be avoided. If the arm is paralyzed, subluxation (incomplete dislocation) at the shoulder can occur as a result of overstretching of the joint capsule and musculature by the force of gravity when the patient sits or stands in the early stages after a stroke. This results in severe pain. Shoulder–hand syndrome (painful shoulder and generalized swelling of the hand) can cause a frozen shoulder and ultimately atrophy of subcutaneous tissues. When a shoulder becomes stiff, it is usually painful.

Many shoulder problems can be prevented by proper patient movement and positioning. The flaccid arm is positioned on a table or with pillows while the patient is seated. Some clinicians advocate the use of a properly worn sling when the patient first becomes ambulatory, to prevent the paralyzed upper extremity from dangling without support. Range-of-motion exercises are important in preventing painful shoulder. Overstrenuous arm movements are avoided. The patient is instructed to interlace the fingers, place the palms together, and push the clasped hands slowly forward to bring the scapulae forward; he or she then raises both hands above the head. This is repeated throughout the day. The patient is instructed to flex the affected wrist at intervals and move all the joints of the affected fingers. The patient is encouraged to touch, stroke, rub, and look at both hands. Pushing the heel of the hand firmly down on a surface is useful. Elevation of the arm and hand is also important in preventing dependent edema of the hand. Patients with continuing pain after attempted movement and positioning may require the addition of analgesia to their treatment program. Other treatments may include injections to the shoulder joint with corticosteroid medications or botulinum toxin type A, shoulder strapping, acupuncture, electrical stimulation, heat or ice, and soft tissue massage (Zheng & Alexander, 2015).

Medications are often helpful in the management of poststroke pain. The medications that are used include: amitriptyline (Elavil), gabapentin (Neurontin), lamotrigine (Lamictal), and pregabalin (Lyrica) (Flaster, Meresh, Rao, et al., 2013).

Enhancing Self-Care

As soon as the patient can sit up, he or she is encouraged to participate in personal hygiene activities. The patient is helped to set realistic goals; if feasible, a new task is added daily. The first step is to carry out all self-care activities on the unaffected side. Such activities as combing the hair, brushing the teeth, shaving with an electric razor, bathing, and eating can be carried out with one hand and should be encouraged. Although the patient may feel awkward at first, these motor skills can be learned by repetition, and the unaffected side will become stronger with use. The nurse must be sure that the patient does not neglect the affected side. Assistive devices will help make up for some of the patient's deficits (see Chart 50-4). A small towel is easier to control while drying after bathing, and boxed paper tissues are easier to use than a roll of toilet tissue.

Return of functional ability is important to the patient recovering after a stroke. An early baseline assessment of functional ability with an instrument such as the Functional Independence Measure (FIM™) is important in team planning

Chart 50-4

Assistive Devices to Enhance Self-Care After Stroke

Bathing and Grooming Devices

- Electric razors with head at 90 degrees to handle
- Grab bars, nonskid mats, handheld shower heads
- Long-handled bath sponge
- Shower and tub seats, stationary or on wheels

Dressing Aids

- Elastic shoelaces
- Long-handled shoehorn
- Velcro closures

Eating Devices

- Nonskid mats to stabilize plates
- Plate guards to prevent food from being pushed off plate
- Wide-grip utensils to accommodate a weak grasp

Mobility Aids

- Canes, walkers, wheelchairs
- Transfer devices such as transfer boards and belts

Toileting Aids

- Grab bars next to toilet
- Raised toilet seat

and goal setting for the patient. The FIM™ is a widely used instrument in stroke rehabilitation and provides valuable information about motor, social, and cognitive function. The patient's morale may improve if ambulatory activities are carried out in street clothes. The family is instructed to bring in clothing that is preferably a size larger than that usually worn. Clothing fitted with front or side fasteners or Velcro closures is the most suitable. The patient has better balance if most of the dressing activities are carried out while seated.

Perceptual problems may make it difficult for the patient to dress without assistance because of an inability to match the clothing to the body parts. To assist the patient, the nurse can take steps to keep the environment organized and uncluttered, because the patient with a perceptual problem is easily distracted. The clothing is placed on the affected side in the order in which the garments are to be put on. The use of a large mirror while dressing promotes the patient's awareness of what he or she is putting on the affected side. The patient has to make many compensatory movements when dressing; these can produce fatigue and painful twisting of the intercostal muscles. Support and encouragement are provided to prevent the patient from becoming overly fatigued and discouraged. Even with intensive training, not all patients can achieve independence in dressing.

Adjusting to Physical Changes

Patients with a decreased field of vision should be approached on the side where visual perception is intact. All visual stimuli (e.g., clock, calendar, television) should be placed on this side. The patient can be educated to turn the head in the direction of the defective visual field to compensate for this loss. The nurse should make eye contact with the patient and draw their attention to the affected side by encouraging the patient to move the head. The nurse may also want to stand at a position that encourages the patient to move or turn to visualize who is in the room. Increasing the natural or artificial lighting in the room and providing eyeglasses are important aids to increasing vision.

The patient with homonymous hemianopsia turns away from the affected side of the body and tends to neglect that side and the space on that side; this is known as amorphosynthesis. In such instances, the patient cannot see food on half of the tray, and only half of the room is visible. It is important for the nurse to constantly remind the patient of the other side of the body; to maintain alignment of the extremities; and, if possible, to place the extremities where the patient can see them.

Assisting With Nutrition

Stroke can result in dysphagia (difficulty swallowing) due to impaired function of the mouth, tongue, palate, larynx, pharynx, or upper esophagus. Patients must be observed for paroxysms of coughing, food dribbling out of or pooling in one side of the mouth, food retained for long periods in the mouth, or nasal regurgitation when swallowing liquids. Swallowing difficulties place the patient at risk for aspiration, pneumonia, dehydration, and malnutrition.

A swallow assessment should be performed as soon as possible after the patient's arrival to the ED (preferably within 4 to 24 hours). This is done before allowing any oral intake. A speech therapist will evaluate the patient's swallowing ability, but an assessment may also be done by the nurse using a validated and reliable assessment tool (Middleton et al., 2015).

If swallowing function is partially impaired, it may return over time, or the patient may be educated in alternative swallowing techniques, advised to take smaller boluses of food, and educated about types of foods that are easier to swallow. The patient may be started on a thick liquid or pureed diet, because these foods are easier to swallow than thin liquids. Having the patient sit upright, preferably out of bed in a chair, and instructing him or her to tuck the chin toward the chest as he or she swallows will help prevent aspiration. The diet may be advanced as the patient becomes more proficient at swallowing. If the patient cannot resume oral intake, a gastrointestinal feeding tube is placed for ongoing tube feedings and medication administration.

Enteral tubes can be either nasogastric (placed in the stomach) or nasoenteral (placed in the duodenum) to reduce the risk of aspiration. Nursing responsibilities in feeding include elevating the head of the bed at least 30 degrees to prevent aspiration, checking the position of the tube before feeding, ensuring that the cuff of the tracheostomy tube (if in place) is inflated, and giving the tube feeding slowly. The feeding tube is aspirated periodically to ensure that the feedings are passing through the gastrointestinal tract. Retained or residual feedings increase the risk of aspiration. Patients with retained feedings may benefit from the placement of a gastrostomy tube or a percutaneous endoscopic gastrostomy tube. In a patient with a feeding tube, the tube should be placed in the duodenum to reduce the risk of aspiration. For long-term feedings, a gastrostomy tube is preferred (see Chapter 15).

Attaining Bladder and Bowel Control

After a stroke, the patient may have transient urinary incontinence due to confusion, inability to communicate needs, and inability to use the urinal or bedpan because of impaired motor and postural control. Occasionally after a stroke, the bladder becomes atonic, with impaired sensation in response to bladder filling. Sometimes, control of the external urinary sphincter is lost or diminished. During this period, intermittent catheterization with sterile technique is carried out. After muscle tone increases and deep tendon reflexes return, bladder tone increases and spasticity of the bladder may develop. Because the patient's sense of awareness is clouded, persistent

urinary incontinence or urinary retention may be symptomatic of bilateral brain damage. The voiding pattern is analyzed, and the urinal or bedpan is offered on this pattern or schedule. The upright posture and standing position are helpful for male patients during this aspect of rehabilitation.

Patients may have problems with bowel control, particularly constipation. Unless contraindicated, a high-fiber diet and adequate fluid intake (2 to 3 L/day) should be provided, and a regular time (usually after breakfast) should be established for toileting.

Improving Thought Processes

After a stroke, the patient may have problems with cognitive, behavioral, and emotional deficits related to brain damage. However, in many instances, a considerable degree of function can be recovered, because not all areas of the brain are equally damaged; some remain more intact and functional than others.

After assessment that delineates the patient's deficits, the neuropsychologist, in collaboration with the primary provider, psychiatrist, nurse, and other professionals, structures a training program using cognitive-perceptual retraining, visual imagery, reality orientation, and cueing procedures to compensate for losses.

The role of the nurse is supportive. The nurse reviews the results of neuropsychological testing; observes the patient's performance and progress; gives positive feedback; and, most importantly, conveys an attitude of confidence and hope. Interventions capitalize on the patient's strengths and remaining abilities while attempting to improve performance of affected functions. Other interventions are similar to those for improving cognitive functioning after a head injury (see Chapter 51).

Improving Communication

Aphasia, which impairs the patient's ability to express him- or herself and to understand what is being said, may become apparent in various ways. The cortical area that is responsible for integrating the myriad pathways required for the comprehension and formulation of language is called *Broca area*. It is located in a convolution adjoining the middle cerebral artery. This area is responsible for control of the combinations of muscular movements needed to speak each word. Broca area is so close to the left motor area that a disturbance in the motor area often affects the speech area. This is why so many patients who are paralyzed on the right side (due to damage or injury to the left side of the brain) cannot speak, whereas those paralyzed on the left side are less likely to have speech disturbances.

The speech therapist assesses the communication needs of the patient who has had a stroke, describes the precise deficit, and suggests the best overall method of communication. Most language intervention strategies can be tailored for the individual patient. The patient is expected to take an active part in establishing goals.

A person with aphasia may become depressed. The inability to talk on the telephone, answer a question, or participate in conversation often causes anger, frustration, fear of the future, and hopelessness. Nursing interventions include strategies to make the atmosphere conducive to communication. This includes being sensitive to the patient's reactions and needs and responding to them in an appropriate manner while always treating the patient as an adult. The nurse provides strong emotional support and understanding to allay anxiety and frustration.

A common pitfall is for the nurse or other health care team member to complete the thoughts or sentences of the patient. This should be avoided, because it causes the patient to become more frustrated at not being allowed to speak and may deter efforts to practice putting thoughts together and completing sentences. A consistent schedule, routines, and repetition help the patient to function despite significant deficits. A written copy of the daily schedule, a folder of personal information (birth date, address, names of relatives), checklists, and an audiotaped list help improve the patient's memory and concentration. The patient may also benefit from a communication board, which has pictures of common needs and phrases. The board may be translated into any language.

Chart 50-5

Communicating with the Patient with Aphasia

- Face the patient and establish eye contact.
- Speak in a clear, unhurried manner, and normal tone of voice.
- Use short phrases, and pause between phrases to allow the patient time to understand what is being said.
- Limit conversation to practical and concrete matters.
- Use gestures, pictures, objects, and writing.
- As the patient uses and handles an object, say what the object is. It helps to match the words with the object or action.
- Be consistent in using the same words and gestures each time you give instructions or ask a question.
- Keep extraneous noises and sounds to a minimum. Too much background noise can distract the patient or make it difficult to sort out the message being spoken.

When talking with the patient, it is important for the nurse to gain the patient's attention, speak slowly, and keep the language of instruction consistent. One instruction is given at a time, and time is allowed for the patient to process what has been said. The use of gestures may enhance comprehension. Speaking is thinking out loud, and the emphasis is on thinking. Listening and sorting out incoming messages requires mental effort; the patient must struggle against mental inertia and needs time to organize a response.

In working with the patient with aphasia, the nurse must remember to talk to the patient during care activities. This provides social contact for the patient. Chart 50-5 describes points to keep in mind when communicating with the patient with aphasia.

Maintaining Skin Integrity

The patient who has had a stroke may be at risk for skin and tissue breakdown because of altered sensation and inability to respond to pressure and discomfort by turning and moving. Preventing skin and tissue breakdown requires frequent assessment of the skin, with emphasis on bony areas and dependent parts of the body. During the acute phase, a specialty bed (e.g., low air-loss bed) may be used until the patient can move independently or assist in moving.

A regular turning schedule (e.g., every 2 hours) is adhered to, even if pressure-relieving devices are used to prevent tissue and skin breakdown. When the patient is positioned or turned, care must be used to minimize shear and friction forces, which cause damage to tissues and predispose the skin to breakdown.

The patient's skin must be kept clean and dry; gentle massage of healthy (nonreddened) skin and adequate nutrition are other factors that help to maintain skin and tissue integrity (see Chapter 51).

Improving Family Coping

Family members play an important role in the patient's recovery. Family members are encouraged to participate in counseling

and to use support systems that will help with the emotional and physical stress of caring for the patient. Involving others in the patient's care and providing education about stress management techniques and methods for maintaining personal health also facilitate family coping.

The family may have difficulty accepting the patient's disability and may be unrealistic in their expectations. They are given information about the expected outcomes and are counseled to avoid doing activities for the patient that he or she can do. They are assured that their love and interest are part of the patient's therapy.

The family needs to be informed that the rehabilitation of the patient with hemiplegia requires many months and that progress may be slow. The gains made by the patient in the hospital or rehabilitation unit must be maintained. All caregivers should approach the patient with a supportive and optimistic attitude, focusing on the patient's remaining abilities. The rehabilitation team, the medical and nursing team, the patient, and the family must all be involved in developing attainable goals for the patient at home.

Most relatives of patients with stroke handle the physical changes better than the emotional aspects of care. The family should be prepared to expect occasional episodes of emotional lability. The patient may laugh or cry easily and may be irritable and demanding or depressed and confused. The nurse can explain to the family that the patient's laughter does not necessarily connote happiness, nor does crying reflect sadness, and that emotional lability usually improves with time.

Family-centered care involves seeing patients and family caregivers as a one unit. Nurses can assess caregivers' strengths and ability to provide care. This assessment should be a continual process because needs change throughout the hospitalization period and rehabilitation stay. Providing information about community resources, respite care and adult day care, and mental health issues (for the patient who has had a stroke and for caregivers) will help with the transition to home (Creasy, Lutz, Young, et al., 2015).

Helping the Patient Cope with Sexual Dysfunction

Sexual functioning can be profoundly altered by stroke. Although research in this area of stroke management is limited, it appears that patients who have had a stroke consider sexual function important, and many have sexual dysfunction. Sexual dysfunction after stroke is multifactorial. There may be medical reasons for the dysfunction (neurologic and cognitive deficits, previous diseases, medications) as well as various psychosocial factors, including depression. A stroke is such a catastrophic illness that the patient experiences loss of self-esteem and value as a sexual being. These psychosocial factors play an important role in determining sexual drive, activity, and satisfaction after a stroke.

Nurses in the rehabilitation setting play a crucial role in beginning a dialogue between the patient and their partner about sexuality after a stroke. In-depth assessments to determine sexual history before and after the stroke should be followed by appropriate interventions. Interventions for the patient and partner focus on providing relevant information, education, reassurance, adjustment of medications, counseling regarding coping skills, suggestions for alternative sexual positions, and a means of sexual expression and satisfaction.

Monitoring and Managing Potential Complications

Decreased cerebral blood flow due to increased ICP, leading to inadequate oxygen delivery to the brain, and pneumonia are potential complications in any patient who has had an ischemic stroke. The more severe the stroke (i.e., the higher the NIHSS), the greater the risk of complications.

During the acute phase of care, a neurologic flow sheet (see Chapter 49, Fig. 49-8) is used to monitor and document assessment parameters. Changes in blood pressure, pulse, and respiration are important clinically because they suggest increased ICP and are reported immediately. If signs and symptoms of pneumonia develop, cultures are obtained to identify the organism so that appropriate antibiotic agents can be given.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. Patient and family education is a fundamental component of stroke recovery. The nurse provides education about stroke, its causes and prevention, and the rehabilitation process. In both acute care and rehabilitation facilities, the focus is on educating the patient to resume as much self-care as possible. This may entail using assistive devices or modifying the home environment to help the patient live with a disability.

An occupational therapist may be helpful in assessing the home environment and recommending modifications to help the patient become more independent. For example, a shower is more convenient than a tub for the patient with hemiplegia because most patients do not gain sufficient strength to get up and down from a tub. Sitting on a stool of medium height with rubber suction tips allows the patient to wash with greater ease. A long-handled bath brush with a soap container is helpful to the patient who has only one functional hand. If a shower is not available, a stool may be placed in the tub and a portable shower hose attached to the faucet. Handrails may be attached alongside the bathtub and the toilet. Other assistive devices include special utensils for eating, grooming, dressing, and writing (see Chart 50-4).

A program of physical therapy can be beneficial, whether it takes place in the home or in an outpatient program. Constraint-induced movement therapy has been used in stroke rehabilitation and involves constraint of the less affected upper limb with a mitt, and intensely training the more affected limb. Robotic-assisted therapy uses sensorimotor training of the upper limb. This method allows patients to train without the presence of a therapist. Recent research has focused on techniques using robotics, virtual reality and video game applications, transcranial magnetic stimulation, and ambulation with body weight support and treadmill training (Brainin & Zorowitz, 2013).

Continuing and Transitional Care. A variety of transitional care models are being used in patients with stroke (Puhr & Thompson, 2015). Some evidence supports positive outcomes using transitional care but more research and standardization of interventions is needed for confirmation (Puhr & Thompson, 2015). Depending on the specific neurologic deficits resulting from the stroke, the patient at home may require the services of a number of health care professionals. The nurse often coordinates the care of the patient at home and considers the many educational needs of caregivers and patients. The family (often the spouse) requires education as well as assistance in planning and providing care.

The family is advised that the patient may tire easily, may become irritable and upset by small events, and may be less interested in events than expected. Emotional problems

associated with stroke are often related to speech dysfunction and the frustrations of being unable to communicate. A speech therapist allows the family to be involved and gives the family practical instructions to help the patient between therapy sessions.

Depression is a common and serious problem in the patient who has had a stroke. The incidence of depression in patients who have had a stroke ranges from 25% to 79%. Risk factors include social isolation, gender (more prevalent in women), a history of depression, and cognitive or physical impairment (Miller, Murray, Richards, et al., 2010). Because the length of hospital stays has shortened, depression may not be identified in the acute setting. Nurses in all care settings should identify patients who may be at risk for depression or who show depressive symptoms (Miller et al., 2010). In the home or in the rehabilitation setting, nurses may be involved in coordinating care and referring patients and family to appropriate resources. The family can help by continuing to support the patient and by giving positive reinforcement for the progress that is being made. Antidepressant therapy may be prescribed, and may help with recovery from stroke (Flaster, Sharma, & Rao, 2013).

Community-based stroke support groups may allow the patient and family to learn from others with similar problems and to share their experiences. Support groups take the form of in-person meetings as well as Internet-based support programs. The patient is encouraged to continue hobbies and recreational and leisure interests and to maintain contact with friends to prevent social isolation. All nurses coming in contact with the patient should encourage the patient to keep active, adhere to the exercise program, and remain as self-sufficient as possible.

The nurse should recognize the potential effects of caregiving on the family. Not all families have the adaptive coping skills and adequate psychological functioning necessary for the long-term care of another person. The patient's spouse may be older, with their own health concerns; in some instances, the patient may have been the provider of care to the spouse. A spouse may have to take on new roles and responsibilities in the relationship and around the home. He or she may also feel a sense of loss (of freedom and leisure time as well as of the marital relationship). Caregivers may also experience social isolation and financial burdens. Depression is common in caregivers of patients who have survived a stroke, with rates as high as 30% to 52% (Miller et al., 2010). Nurses should assess caregivers for signs of depression.

Caregivers may require reminders to attend to their own health concerns and well-being. Even healthy caregivers may find it difficult to maintain a schedule that includes being available around the clock. The nurse encourages the family to arrange for respite care services (planned short-term care to relieve the family from having to provide continuous 24-hour care), which may be available from an adult day care center. Some hospitals also offer weekend respite care that can provide caregivers with needed time for themselves. The nurse involved in home and continuing care also needs to remind the patient and family of the need for respite care as well as continuing health promotion and screening practices.

Evaluation

Expected patient outcomes may include:

1. Achieves improved mobility
   a. Avoids deformities (contractures and foot drop)
   b. Participates in prescribed exercise program
   c. Achieves sitting balance
   d. Uses unaffected side to compensate for loss of function of hemiplegic side
2. Reports absence of shoulder pain
   a. Demonstrates shoulder mobility; exercises shoulder
   b. Elevates arm and hand at intervals
3. Achieves self-care; performs hygiene care; uses adaptive equipment
4. Demonstrates techniques to compensate for the discomfort of sensory deficits, such as turning the head to see people or objects
5. Demonstrates safe swallowing
6. Achieves usual pattern of bowel and bladder elimination
7. Participates in cognitive improvement program
8. Demonstrates improved communication
9. Maintains intact skin without breakdown
   a. Demonstrates skin turgor within normal limits
   b. Participates in turning and positioning activities
10. Family members demonstrate a positive attitude and coping mechanisms
    a. Encourage patient in exercise program
    b. Take an active part in rehabilitation process
    c. Contact respite care programs or arrange for other family members to assume some responsibilities for care
11. Develops alternative approaches to sexual expression
12. Absence of complications
    a. Has ICP values that remain within normal limits
    b. Has no signs and symptoms of pneumonia

Hemorrhagic Stroke

Hemorrhage accounts for approximately 13% of strokes and are primarily caused by intracranial (7%), subarachnoid hemorrhage (8%), and other causes. Hemorrhagic strokes are caused by bleeding into the brain tissue, the ventricles, or the subarachnoid space. Primary intracerebral hemorrhage from a spontaneous rupture of small vessels accounts for approximately 80% of hemorrhagic strokes and is caused chiefly by uncontrolled hypertension. Subarachnoid hemorrhage results from a ruptured intracranial aneurysm (discussed later in this chapter) in about half the cases (Hickey, 2014).

Another common cause of primary intracerebral hemorrhage in the older adult is cerebral amyloid angiopathy (CAA), which involves damage caused by the deposit of beta-amyloid protein in the small- and medium-sized blood vessels of the brain. CAA makes these blood vessels fragile and prone to bleeding. Secondary intracerebral hemorrhage is associated with arteriovenous malformations (AVMs), intracranial aneurysms, intracranial neoplasms, or certain medications (e.g., anticoagulants, amphetamines). The mortality rate has been reported to be as high as 50% after an intracranial hemorrhage (Hickey, 2014). Patients who survive the acute phase of care usually have more severe deficits and a longer recovery phase compared to those with ischemic stroke.

Pathophysiology

The pathophysiology of hemorrhagic stroke depends on the cause and type of cerebrovascular disorder. Symptoms are produced when a primary hemorrhage, aneurysm, or AVM presses on

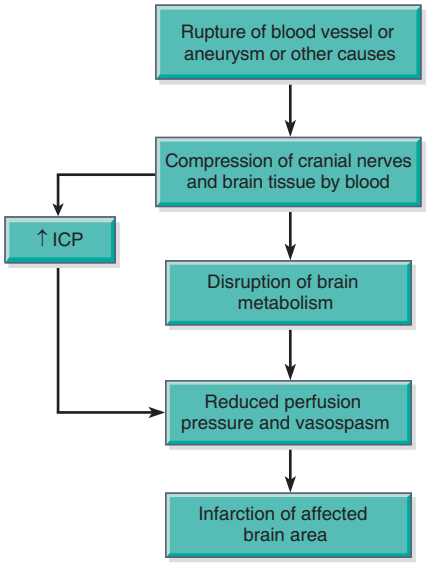


Figure 50-6 • Pathophysiology of hemorrhagic stroke.

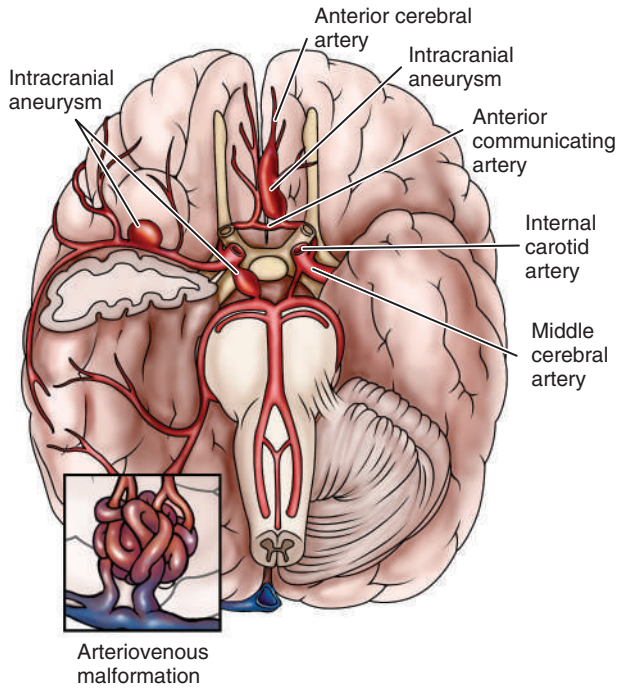


Figure 50-7 • Common sites of intracranial aneurysms and an arteriovenous malformation.

nearby cranial nerves or brain tissue or, more dramatically, when an aneurysm or AVM ruptures, causing subarachnoid hemorrhage (hemorrhage into the cranial subarachnoid space). Normal brain metabolism is disrupted by the brain's exposure to blood; by an increase in ICP resulting from the sudden entry of blood into the subarachnoid space, which compresses and injures brain tissue; or by secondary ischemia of the brain resulting from the reduced perfusion pressure and vasospasm that frequently accompany subarachnoid hemorrhage. A flowchart for pathophysiology of hemorrhagic stroke is presented in Figure 50.6.

Intracerebral Hemorrhage

An intracerebral hemorrhage, or bleeding into the brain tissue, is most common in patients with hypertension and cerebral atherosclerosis, because degenerative changes from these diseases cause rupture of the blood vessel. An intracerebral hemorrhage may also result from certain types of arterial pathology, brain tumors, and the use of medications (e.g., oral anticoagulants, amphetamines, and illicit drug use).

Bleeding related to hypertension occurs most commonly in the deeper structures of the brain (basal ganglia and thalamus); it occurs less frequently in the brainstem (mostly the pons) and cerebellum (Hickey, 2014). Bleeding in the outer cerebral lobes (lobar hemorrhages) in those 75 or older can be related to CAA. Bleeding from CAA frequently is in the frontal and parietal lobes. Occasionally, the bleeding ruptures the wall of the lateral ventricle and causes intraventricular hemorrhage, which is associated with poor outcomes and death (Hickey, 2014).

Intracranial (Cerebral) Aneurysm

An intracranial (cerebral) aneurysm is a dilation of the walls of a cerebral artery that develops as a result of weakness in the arterial wall. The cause of aneurysms is unknown, although research is ongoing. An aneurysm may be due to atherosclerosis, which results in a defect in the vessel wall with subsequent weakness of the wall; a congenital defect of the vessel wall; hypertensive vascular disease; head trauma; or advancing age.

Any artery within the brain can be the site of a cerebral aneurysm, but these lesions usually occur at the bifurcations of the large arteries at the circle of Willis (see Fig. 50-7). The cerebral arteries most commonly affected by an aneurysm are the internal carotid artery, anterior cerebral artery, anterior communicating artery, posterior communicating artery, posterior cerebral artery, and middle cerebral artery. Multiple cerebral aneurysms are not uncommon.

Arteriovenous Malformations

Most AVMs are caused by an abnormality in embryonal development that leads to a tangle of arteries and veins in the brain that lacks a capillary bed (see Fig. 50-7). The absence of a capillary bed leads to dilation of the arteries and veins and eventual rupture. AVM is a common cause of hemorrhagic stroke in young people (Bader, Littlejohns, & Olson, 2016).

Subarachnoid Hemorrhage

A subarachnoid hemorrhage (hemorrhage into the subarachnoid space) may occur as a result of an AVM, intracranial aneurysm, trauma, or hypertension. The most common causes are a leaking aneurysm in the area of the circle of Willis and a congenital AVM of the brain (Bader et al., 2016).

Clinical Manifestations

The patient with a hemorrhagic stroke can present with a wide variety of neurologic deficits, similar to the patient with ischemic stroke. The conscious patient most commonly reports a severe headache. A comprehensive assessment reveals the extent of the neurologic deficits. Many of the same motor, sensory, cranial nerve, cognitive, and other functions that are disrupted after ischemic stroke are also altered after a hemorrhagic stroke. Table 50-2 reviews the neurologic deficits frequently seen in patients who have had a stroke. Table 50-3 compares the symptoms seen in right hemispheric stroke with those seen in left hemispheric stroke. Other symptoms that may be observed more frequently in patients with acute intracerebral hemorrhage (compared with ischemic stroke) are nausea or vomiting, an early sudden change in level of consciousness, and possibly seizures.

In addition to the neurologic deficits (similar to those of ischemic stroke), the patient with an intracranial aneurysm or AVM may have some unique clinical manifestations. Rupture of an aneurysm or AVM usually produces a sudden, unusually severe headache and often loss of consciousness for a variable period of time. There may be pain and rigidity of the back of the neck (nuchal rigidity) and spine due to meningeal irritation. Visual disturbances (visual loss, diplopia, ptosis) occur if the aneurysm is adjacent to the oculomotor nerve. Tinnitus, dizziness, and hemiparesis may also occur.

At times, an aneurysm or AVM leaks blood, leading to the formation of a clot that seals the site of rupture. In this instance, the patient may show little neurologic deficit. In other cases, severe bleeding occurs, resulting in cerebral damage, followed rapidly by coma and death.

Prognosis depends on the neurologic condition of the patient, the patient's age, associated diseases, and the extent and location of the hemorrhage or intracranial aneurysm. Subarachnoid hemorrhage from an aneurysm is a catastrophic event with significant morbidity and mortality.

Assessment and Diagnostic Findings

Any patient with suspected stroke should undergo a CT scan or MRI scan to determine the type of stroke, the size and location of the hematoma, and the presence or absence of ventricular blood and hydrocephalus. Because hemorrhagic stroke is an emergency, CT scan is usually obtained first because it can be done rapidly. Cerebral angiography using the conventional method or CT (CTA) confirms the diagnosis of an intracranial aneurysm or AVM. These tests show the location and size of the lesion and provide information about the affected arteries, veins, adjoining vessels, and vascular branches. Lumbar puncture may be performed if there is no evidence of increased ICP, the CT scan results are negative, and subarachnoid hemorrhage must be confirmed. Lumbar puncture in the presence of increased ICP could result in brainstem herniation or rebleeding. When diagnosing a hemorrhagic stroke in a patient younger than 40 years, some clinicians obtain a toxicology screen for illicit drug use.

Prevention

Primary prevention of hemorrhagic stroke is the best approach and includes managing hypertension and ameliorating other significant risk factors. Control of hypertension can reduce the risk of hemorrhagic stroke. Additional risk factors are increased age, male gender, certain ethnicities (Latino, African American, and Japanese) and moderate or excessive alcohol intake (Hickey, 2014). Stroke risk screenings provide an ideal opportunity to lower hemorrhagic stroke risk by identifying individuals or groups at high risk and educating patients and the community about recognition and prevention.

Complications

Potential complications of hemorrhagic stroke include rebleeding or hematoma expansion; cerebral vasospasm resulting in cerebral ischemia; acute hydrocephalus, which results when free blood obstructs the reabsorption of cerebrospinal fluid (CSF) by the arachnoid villi; and seizures.

Cerebral Hypoxia and Decreased Blood Flow

Immediate complications of a hemorrhagic stroke include cerebral hypoxia, decreased cerebral blood flow, and extension of the area of injury. Providing adequate oxygenation of blood to the brain minimizes cerebral hypoxia. Brain function depends on delivery of oxygen to the tissues. Administering supplemental oxygen and maintaining the hemoglobin and hematocrit at acceptable levels will assist in maintaining tissue oxygenation.

Cerebral blood flow depends on the blood pressure, cardiac output, and integrity of cerebral blood vessels. Adequate hydration (IV fluids) must be ensured to reduce blood viscosity and improve cerebral blood flow. Extremes of hypertension or hypotension need to be avoided to prevent changes in cerebral blood flow and the potential for extending the area of injury.

A seizure can also compromise cerebral blood flow, resulting in further injury to the brain. Observing for seizure activity and initiating appropriate treatment are important components of care after a hemorrhagic stroke.

Vasospasm

The development of cerebral vasospasm (narrowing of the lumen of the involved cranial blood vessel) is a serious complication of subarachnoid hemorrhage and is a leading cause of morbidity and mortality in those who survive the initial subarachnoid hemorrhage. Of those with cerebral vasospasm, 15% to 20% die (Wuchner, Bakas, Adams, et al., 2012). The mechanism responsible for vasospasm is not clear, but it is associated with increasing amounts of blood in the subarachnoid cisterns and cerebral fissures, as visualized by CT scan. Monitoring for vasospasm may be performed through the use of bedside transcranial Doppler ultrasonography or follow-up cerebral angiography (Connolly, Rabinstein, Carhuapoma, et al., 2012).

Vasospasm most frequently occurs 7 to 10 days after initial hemorrhage (Connolly et al., 2012), when the clot undergoes lysis (dissolution), and the chance of rebleeding is increased. It leads to increased vascular resistance, which impedes cerebral blood flow and causes brain ischemia (delayed cerebral ischemia) and infarction. The signs and symptoms reflect the areas of the brain involved. Vasospasm is often heralded by a worsening headache, a decrease in level of consciousness (confusion, lethargy, and disorientation), or a new focal neurologic deficit (aphasia, hemiparesis).

Management of vasospasm remains difficult and controversial. It is believed that early surgery to clip the aneurysm prevents rebleeding and that removal of blood from the basal cisterns around the major cerebral arteries may prevent vasospasm.

Medication may be effective in the treatment and prevention of vasospasm. Based on the theory that vasospasm is caused by an increased influx of calcium into the cell, medication therapy may be used either to block or antagonize this action, or to prevent or reverse the action of vasospasm if already present. Nimodipine is the most studied calcium channel blocker for prevention of vasospasm in subarachnoid hemorrhage. An oral solution of nimodipine (Nymalize) was approved by the FDA in 2013; prior to this approval, the medication was only available in a liquid filled gel capsule (Nimotop). Current guidelines recommend that nimodipine be prescribed for all patients with subarachnoid hemorrhage (Connolly et al., 2012). This is currently the only drug approved by the FDA for the prevention and treatment of vasospasm in subarachnoid hemorrhage.

Another therapy for vasospasm and the resulting delayed cerebral ischemia, referred to as triple-H therapy, is aimed at minimizing the deleterious effects of the associated cerebral ischemia and includes (1) fluid volume expanders (hypervolemia), (2) induced arterial hypertension, and (3) hemodilution. However,

current research and guidelines now endorse euvolemia to prevent delayed cerebral ischemia and induced arterial hypertension for treatment of delayed cerebral ischemia (Connolly et al., 2012).

Increased Intracranial Pressure

An increase in ICP can occur after either an ischemic or a hemorrhagic stroke but almost always follows a subarachnoid hemorrhage, usually because of disturbed circulation of CSF caused by blood in the basal cisterns. Neurologic assessments are performed frequently, and if there is evidence of deterioration from increased ICP (due to cerebral edema, herniation, hydrocephalus, or vasospasm), CSF drainage may be instituted by ventricular catheter drainage (Hemphill, Greenberg, Anderson, et al., 2015). Mannitol may be given to reduce ICP. When mannitol is used as a long-term measure to control ICP, dehydration and disturbances in electrolyte balance (hyponatremia or hypernatremia; hypokalemia or hyperkalemia) may occur. Mannitol pulls water out of the brain tissue by osmosis and reduces total body water through diuresis. The patient's fluid balance is monitored continuously and is assessed for signs of dehydration and for rebound elevation of ICP. Other interventions may include elevating the head of the bed to 30 degrees, avoidance of hyperglycemia and hypoglycemia, sedation, and use of hypertonic saline in a variety of concentrations (e.g., 3%, 7.5%, or 23%) (Wijdicks et al., 2014).

Hypertension

Hypertension is the most common cause of intracerebral hemorrhage, and its treatment is critical. Specific goals for blood pressure management, which are individualized for each patient, remain controversial. Blood pressure goals may depend on the presence of increased ICP. Recently published guidelines for management of intracerebral hemorrhage recommend early blood pressure lowering (if the systolic blood pressure is between 150 and 220 mm Hg) to a goal systolic of 140 mm Hg, and report that lowering blood pressure can be effective for improving patient outcomes. If systolic blood pressure is above 220 mm Hg, IV continuous infusions of antihypertensives may be prescribed (Hemphill et al., 2015). Nicardipine (Cardene) is one agent that may be used as a continuous IV infusion. Labetalol (Trandate) and hydralazine (Apresoline) are other examples of medications that may be given as an IV bolus. During the administration of antihypertensive agents, hemodynamic monitoring is important to detect and avoid a precipitous drop in blood pressure, which can produce brain ischemia. Stool softeners are used to prevent straining, which can elevate the blood pressure.

Medical Management

The goals of medical treatment for hemorrhagic stroke are to allow the brain to recover from the initial insult (bleeding), to prevent or minimize the risk of rebleeding, and to prevent or treat complications. Management may consist of bed rest with sedation to prevent agitation and stress, management of vasospasm, and surgical or medical treatment to prevent rebleeding. If the bleeding is caused by anticoagulation with warfarin, the INR may be corrected with fresh-frozen plasma and vitamin K. Reversing the anticoagulation effect of the new oral anticoagulants is more complicated. Protocols may include hemodialysis, the use of oral activated charcoal, administration of prothrombin complex concentrates, or administration of recombinant activated factor VII (Kaatz, Kouides, Garcia, et al., 2012). Idarucizumab (Praxbind) is a medication that was recently approved for reversing dabigatran (Pradaxa). If seizures occur, they are treated with anticonvulsant drugs such as phenytoin (Dilantin). Hyperglycemia should also be treated, and hypoglycemia is avoided. Intermittent pneumatic compression devices should be used starting on the first day of the hospital admission to prevent DVT. If the patient is not mobile after 1 to 4 days from the onset of the hemorrhage and there is documentation of the bleeding ceasing, then DVT prevention medications (low–molecular-weight heparin or unfractionated heparin) may be prescribed (Hemphill et al., 2015). Analgesic agents may be prescribed for head and neck pain. Fever should be treated with acetaminophen/paracetamol (Tylenol), iced saline boluses, and devices such as cooling blankets (Bader et al., 2016). After discharge, most patients will require antihypertensive medications to decrease their risk of another intracerebral hemorrhage.

Surgical Management

In many cases, a primary intracerebral hemorrhage is not treated surgically. However, if the patient is showing signs of worsening neurologic examination, increased ICP, or signs of brainstem compression, then surgical evacuation is recommended for the patient with a cerebellar hemorrhage (Hemphill et al., 2015). Surgical evacuation is most frequently accomplished via a craniotomy (see Chapter 49).

The patient with an intracranial aneurysm is prepared for surgical intervention as soon as their condition is considered stable. Surgical treatment of the patient with an unruptured aneurysm is an option. The goal of surgery is to prevent bleeding in an unruptured aneurysm or further bleeding in an already ruptured aneurysm. This objective is accomplished by isolating the aneurysm from its circulation or by strengthening the arterial wall. An aneurysm may be excluded from the cerebral circulation by means of a ligature or a clip across its neck. If this is not anatomically possible, the aneurysm can be reinforced by wrapping it with some substance to provide support and induce scarring.

Advances in technology have led to the introduction of interventional neuroradiology for the treatment of aneurysms. These techniques are now being used more frequently. Endovascular techniques may be used in selected patients to occlude the blood flow from the artery that feeds the aneurysm with coils, liquid embolic agents, or other techniques to occlude the aneurysm itself. If the aneurysm is very large or very wide at its neck, a stent-like device made of a very fine mesh may be used to divert the blood flow away from the aneurysm. The determination of which technique should be used is based on many factors (characteristics of the patient and aneurysm) and is made by experienced endovascular specialists (Connolly et al., 2012); (Thompson, Brown, Amin-Hanjani, et al., 2015).

Postoperative complications are rare but can occur. Potential complications include psychological symptoms (disorientation, amnesia, Korsakoff syndrome [disorder characterized by psychosis, disorientation, delirium, insomnia, hallucinations, personality changes]), intraoperative embolization or artery rupture, postoperative artery occlusion, fluid and electrolyte disturbances (from dysfunction of the neurohypophyseal system), and gastrointestinal bleeding.

NURSING PROCESS

The Patient with a Hemorrhagic Stroke

Assessment

A complete neurologic assessment is performed initially and includes evaluation for the following:

- Altered level of consciousness
- Sluggish pupillary reaction
- Motor and sensory dysfunction
- Cranial nerve deficits (extraocular eye movements, facial droop, presence of ptosis)
- Speech difficulties and visual disturbance
- Headache and nuchal rigidity or other neurologic deficits

All patients should be monitored in the intensive care unit after an intracerebral or subarachnoid hemorrhage. Neurologic assessment findings are documented and reported as indicated. The frequency of these assessments varies depending on the patient's condition. Any changes in the patient's condition require reassessment and thorough documentation; changes should be reported immediately.

Nursing Alert: Alteration in level of consciousness often is the earliest sign of deterioration in a patient with a hemorrhagic stroke. Because nurses have the most frequent contact with patients, they are in the best position to detect subtle changes. Drowsiness and slight slurring of speech may be early signs that the level of consciousness is deteriorating.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Risk for ineffective tissue perfusion (cerebral) related to bleeding or vasospasm
- Anxiety related to illness and/or medically imposed restrictions (aneurysm precautions)

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Vasospasm
- Seizures
- Hydrocephalus
- Rebleeding
- Hyponatremia

Planning and Goals

The goals for the patient may include improved cerebral tissue perfusion, relief of anxiety, and the absence of complications.

Nursing Interventions

Optimizing Cerebral Tissue Perfusion

The patient is closely monitored for neurologic deterioration resulting from recurrent bleeding, increasing ICP, or vasospasm. A neurologic flow record is maintained. The blood pressure, pulse, level of consciousness (an indicator of cerebral perfusion), pupillary responses, and motor function are checked hourly. Respiratory status is monitored, because a reduction in oxygen in areas of the brain with impaired autoregulation increases the chances of a cerebral infarction. Any changes are reported immediately.

Implementing Aneurysm Precautions. Cerebral aneurysm precautions are implemented for the patient with a diagnosis of aneurysm to provide a nonstimulating environment, prevent increases in ICP, and prevent further bleeding. The patient is placed on bed rest in a quiet, nonstressful environment, because activity, pain, and anxiety are thought to elevate the blood pressure, which may increase the risk for bleeding. Visitors may be restricted (American Association of Neuroscience Nurses [AANN], 2009); (Hickey, 2014).

The head of the bed is elevated 30 degrees to promote venous drainage and decrease ICP. Any activity that suddenly increases the blood pressure or obstructs venous return is avoided. This includes the Valsalva maneuver, straining, forceful sneezing, pushing oneself up in bed and acute flexion or rotation of the head and neck (which compromises the jugular veins). Stool softeners and mild laxatives are prescribed. Both prevent constipation, which can cause an increase in ICP. Dim lighting is helpful, because photophobia (visual intolerance of light) is common. The purpose of aneurysm precautions should be thoroughly explained to both the patient (if possible) and family. Intermittent pneumatic compression devices are prescribed to decrease the incidence of DVT resulting from immobility. The legs are observed for signs and symptoms of DVT (tenderness, redness, swelling, warmth, and edema), and abnormal findings are reported.

Relieving Anxiety

Sensory stimulation is kept to a minimum for patients on aneurysm precautions. For patients who are awake, alert, and oriented, an explanation of the restrictions helps reduce the patient's sense of isolation. Reality orientation is provided to help maintain orientation.

Keeping the patient well informed of the plan of care provides reassurance and helps minimize anxiety. Appropriate reassurance also helps relieve the patient's fears and anxiety. The family also requires information and support.

Monitoring and Managing Potential Complications

Vasospasm. The patient is assessed for signs of possible vasospasm: intensified headaches, a decrease in level of responsiveness (confusion, disorientation, lethargy), or evidence of aphasia or partial paralysis. These signs may develop several days after surgery or on the initiation of treatment and must be reported immediately. The calcium channel blocker nimodipine should be given for prevention of vasospasm, and fluid volume expanders in the form of triple-H therapy may be prescribed as well (Connolly et al., 2012).

Seizures. Seizure precautions are maintained for every patient who may be at risk for seizure activity. Should a seizure occur, maintaining the airway and preventing injury are the primary goals. Medication therapy is initiated at this time (see Chapter 51).

Hydrocephalus. Blood in the subarachnoid space or ventricles impedes the circulation of CSF, resulting in hydrocephalus. A CT scan that indicates dilated ventricles confirms the diagnosis. Hydrocephalus can occur within the first 24 hours (acute) after subarachnoid hemorrhage or several days (subacute) to several weeks (delayed) later. Symptoms vary according to the time of onset and may be nonspecific. Acute hydrocephalus is characterized by sudden onset of stupor or coma and is managed with a ventriculostomy drain to decrease ICP. Symptoms of subacute and delayed hydrocephalus include gradual onset of drowsiness, behavioral changes, and ataxic

gait. A ventriculoperitoneal shunt is surgically placed to treat chronic hydrocephalus. Changes in patient responsiveness are reported immediately.

Rebleeding. The rate of recurrent hemorrhage is approximately 1% to 5% per patient per year after intracerebral hemorrhage (Hemphill et al., 2015). Hypertension is the most serious and modifiable risk factor, which shows the importance of appropriate antihypertensive treatment.

Aneurysm rebleeding is the highest during the first 2 to 12 hours after the initial hemorrhage (Connolly et al., 2012) and is considered a major complication. Symptoms of rebleeding include sudden severe headache, nausea, vomiting, decreased level of consciousness, and neurologic deficit. Rebleeding is confirmed by CT scan. Blood pressure is carefully maintained with medications. The most effective preventive treatment is to secure the aneurysm if the patient is a candidate for surgery or endovascular treatment.

Hyponatremia. After subarachnoid hemorrhage, hyponatremia is found in 10% to 30% of patients. Hyponatremia has been found to be associated with the onset of vasospasm (Connolly et al., 2012). Laboratory data must be checked frequently, and hyponatremia (defined as a serum sodium concentration less than 135 mEq/L) must be identified as early as possible. The patient's primary provider needs to be notified of a low serum sodium level that has persisted for 24 hours or longer. The patient is then evaluated for syndrome of inappropriate antidiuretic hormone (SIADH) or cerebral salt-wasting syndrome. SIADH is described in Chapter 7. Cerebral salt-wasting syndrome occurs when the kidneys are unable to conserve sodium and volume depletion results. The treatment most often is the use of IV hypertonic 3% saline.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. The patient and family are provided with education that will enable them to cooperate with the care and restrictions required during the acute phase of hemorrhagic stroke and to prepare them to return home. Patient and family education includes information about the causes of hemorrhagic stroke and its possible consequences. In addition, the patient and family are informed about the medical treatments that are implemented, including surgical intervention if warranted, and the importance of interventions taken to prevent and detect complications (i.e., aneurysm precautions, close monitoring of the patient). Depending on the presence and severity of neurologic impairment and other complications resulting from the stroke, the patient may be transferred to a rehabilitation unit or center for additional patient and family education about strategies to regain self-care ability. Education addresses the use of assistive devices or modification of the home environment to help the patient live with the disability. Modifications of the home may be required to provide a safe environment.

Continuing and Transitional Care. The acute and rehabilitation phase of care focuses on obvious needs, issues, and deficits for the patient with a hemorrhagic stroke. The patient and family are reminded of the importance of following recommendations to prevent further hemorrhagic stroke and keeping follow-up appointments with health care providers for monitoring of risk factors. Referral for home, community-based, or transitional care may be warranted to assess the home environment and the ability of the patient and to ensure that the patient and family are able to manage at home. Home visits provide opportunities to monitor the physical and psychological status of the patient and the ability of the family to cope with any alterations in the patient's status. In addition, the home care nurse reminds the patient and family of the importance of continuing health promotion and screening practices. Chart 50-6 lists education for the patient recovering from a stroke.

Chart 50-6 HOME CARE CHECKLIST

The Patient Recovering from a Stroke

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of the stroke on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State names, dose, side effects, frequency and schedule for all medications.
- State how to contact all members of the treatment team (e.g., health care providers, home care professionals, rehabilitation team, and durable medical equipment and supply vendor).
- State changes in lifestyle (e.g., diet, ADLs, IADLs, activity) necessary for recovery and health maintenance as applicable.
  - Demonstrate environmental modifications and adaptive techniques for accomplishing activities of daily living.
  - Demonstrate home exercises, the use of splints or orthotics, proper positioning, and frequent repositioning.
  - Identify safety measures to prevent falls.
  - Identify holistic interventions for pain management (e.g., positioning, distraction).
  - Describe procedures for maintaining skin integrity.
  - Demonstrate indwelling catheter care, if applicable. Describe a bowel and bladder elimination program as appropriate.
  - Verbalize dietary adjustments (e.g., thickened liquids, pureed diet, small frequent meals) during recovery.
  - Demonstrate swallowing techniques or care of enteral feeding tube.
- Identify psychosocial consequences of stroke (e.g., depression, emotional lability, frustration, fatigue) and appropriate interventions.
- Discuss measures to prevent subsequent strokes.
- Identify potential complications and discuss measures to prevent them (blood clots, aspiration, pneumonia, urinary tract infection, fecal impaction, skin breakdown, contracture).
- Relate how to reach primary provider with questions or complications.
- State time and date of follow-up medical appointments, therapy, and testing.
- Identify resources and other sources of support (e.g., friends, relatives, faith community, stroke support groups, caregiver support).
- Identify the need for health promotion, disease prevention, and screening activities
- Identify appropriate recreational or diversional activities

ADL, activities of daily living; IADL, independent activities of daily living.

Evaluation

Expected patient outcomes may include:

1. Demonstrates stable neurologic status and vital signs and respiratory patterns within normal limits
   a. Is alert and oriented to time, place, and person
   b. Demonstrates understandable speech patterns and stable cognitive processes
   c. Demonstrates usual and equal strength, movement, and sensation of all four extremities
   d. Exhibits deep tendon reflexes and pupillary responses within normal limits

2. Exhibits reduced anxiety level
   a. States rationale for aneurysm precautions
   b. Exhibits clear thought processes
   c. Is less restless
   d. Exhibits absence of physiologic indicators of anxiety (e.g., has vital signs within normal limits; usual respiratory rate; absence of excessive, fast speech)
3. Is free of complications
   a. Exhibits absence of vasospasm
   b. Exhibits vital signs within normal limits and is without seizures
   c. Verbalizes understanding of seizure precautions
   d. Exhibits intact mental, motor, and sensory status
   e. Reports no visual changes

CRITICAL THINKING EXERCISES

1. A 72-year-old male is in the ED being evaluated for a suspected stroke. Identify the priorities, approach and techniques you would use to provide care for him. What are specific time goals for obtaining a head CT scan? If he is eligible for t-PA, how will your priorities change? If his stroke is a hemorrhagic stroke, how will your approach, techniques, and priorities change?
2. You are caring for a patient after a large ischemic stroke. The patient has hemiplegia and is beginning to experience shoulder pain on the side affected by the stroke. Identify the priority nursing interventions that can be implemented to prevent shoulder pain. What education can you provide to the patient for interventions that can be done at home once discharged?
3. A 69-year-old woman has experienced a brainstem stroke. She has just arrived to the nursing unit from the ED and you are her nurse. She has not had a swallow assessment yet. What is the time goal for obtaining an evaluation of her swallowing function? Evaluate the strength of the evidence to support nurses performing dysphagia screening.

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

American Association of Neuroscience Nurses (AANN). (2009). Guide to the care of the patient with aneurysmal subarachnoid hemorrhage: AANN clinical practice guideline series. Glenview, IL: Author.

Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Karch, A. (2014). 2015 Lippincott's nursing drug guide. Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

Anderson, J. (2016). Acute ischemic stroke: The golden hour. Nursing Critical Care, 11(3), 28–36.

*Aycock, D. M., & Clark, P. C. (2016). Incongruence between perceived long-term risk and actual risk of stroke in rural African Americans. Journal of Neuroscience Nursing, 48(1), 35–41.

Bentz, B. (2015). Nonvitamin K antagonist oral anticoagulants in everyday practice: Stroke prevention in atrial fibrillation and treatment of venous thromboembolism. Journal of the American Association of Nurse Practitioners, 27(12), 721–731.

Bharucha, N. E., Bharucha, E. P., Bharucha, A. E., Bhise, A. V, & Schoenberg, B. S. (1988). Prevalence of stroke in the Parsi community of Bombay. Stroke, 19(1), 60–62.

Brainin, M., & Zorowitz, R. (2013). Advances in stroke: Recovery and rehabilitation. Stroke, 44(2), 311–313.

Connolly, E., Rabinstein, A., Carhuapoma, J., et al. (2012). Guidelines for the management of aneurysmal subarachnoid hemorrhage: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 43(6), 1711–1737.

*Creasy, K. R., Lutz, B. J., Young, M. E., et al. (2015). Clinical implications of family-centered care in stroke rehabilitation. Rehabilitation Nursing, 40(6), 349–359.

Del Zoppo, G. J., Saver, J. L., Jauch, E. C., et al; American Heart Association Stroke Council (2009). Expansion of the time window for treatment of acute ischemic stroke with intravenous tissue plasminogen activator: A science advisory from the American Heart Association/American Stroke Association. Stroke, 40(8), 2945–2948.

Ennen, K. A. (2013). Taking a second look at stroke in women. American Nurse Today, 8(5), 12–15.

Flaster, M., Meresh, E., Rao, M., et al. (2013). Central poststroke pain: Current diagnosis and treatment. Topics in Stroke Rehabilitation, 20(2), 116–123.

Flaster, M., Sharma, A., & Rao, M. (2013). Poststroke depression: A review emphasizing the role of prophylactic treatment and synergy with treatment for motor recovery. Topics In Stroke Rehabilitation, 20(2), 139–150.

Hemphill, J. C., Greenberg, S. M., Anderson, C. S., et al. (2015). Guidelines for the management of spontaneous intracerebral hemorrhage: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 46(7), 2032–2060.

Jauch, E. C., Saver, J. L., Adams, H. P., et al. (2013). Guidelines for the early management of patients with ischemic stroke: A guideline from the American Heart Association/American stroke Association. Stroke, 44(1), 870–947.

Kaatz, S., Kouides, P. A., Garcia, D. A., et al. (2012). Guidance on the emergent reversal of oral thrombin and factor Xa inhibitors. American Journal of Hematology, 87(Suppl. 1), S141–S145.

Kernan, W. N., Ovbiagele, B., Black, H. R., et al. (2014). Guidelines for the prevention of stroke in patients with stroke and transient ischemic attack: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 45(7), 2160–2236.

Meschia, J. F., Bushnell, C., Boden-Albala, B., et al. (2014). Guidelines for the primary prevention of stroke: A statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 45(12), 3754–3832.

Middleton, S., Grimley, R., & Alexandrov, A. W. (2015). Triage, treatment, and transfer: Evidence-based clinical practice recommendations and models of nursing care for the first 72 hours of admission to hospital for acute stroke. Stroke, 46(2), e18–e25.

Miller, E. L., Murray, L., Richards, L., et al. (2010). Comprehensive overview of nursing and interdisciplinary rehabilitation care of the stroke patient: A scientific statement from the American Heart Association. Stroke, 41(10), 2402–2448.

Miller, E. T., & Summers, D. (2014). Update on transient ischemic attack nursing care. Stroke, 45(5), e71–e73.

Mozaffarian, D., Benjamin, E. J., Go, A. S., et al. (2016). AHA statistical update: Heart disease and stroke statistics—2016 update: A report from the American Heart Association. Circulation, 133(4), e38–e360.

**National Institute of Neurologic Disorders and Stroke. (1995). Tissue plasminogen activator for acute ischemic stroke. The National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group. New England Journal of Medicine, 333(24), 1581–1587.

National Institute of Neurological Disorders and Stroke, National Institutes of Health. National Institutes of Health Stroke Scale. Retrieved

on 4/23/17 at: www.ninds.nih.gov/sites/default/files/NIH_Stroke_Scale_Booklet.pdf

Powers, W. J., Derdeyn, C. P., Biller J., et al. (2015). AHA/ASA guideline: 2015 AHA/ASA focused update of the 2013 guidelines for the early management of acute ischemic stroke regarding endovascular treatment. A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 46(6), 3020–3035.

Pandian, J. D., & Sudhan, P. (2013). Stroke epidemiology and stroke care services in India. *Journal of Stroke*, *15*(3), 128.

Prasad, K., Vibha, D., & Meenakshi. (2012). Cerebrovascular disease in South Asia–Part I: A burning problem. JRSM Cardiovascular Disease, 1(7), 1–7.

Puhr, M. I., & Thompson, H. J. (2015). The use of transitional care models in patients with stroke. Journal of Neuroscience Nursing, 47(4), 223–234.

**Saver, J. L. (2006). Time is brain quantified. Stroke, 37(1), 263–266.

Stroke. In: Assessment of the burden of non-communicable diseases: Final project report. (2004). New Delhi.

Summers, D., Leonard, A., Wentworth, D., et al. (2009). Comprehensive overview of nursing and interdisciplinary care of the acute ischemic stroke patient: A scientific statement from the American Heart Association. Stroke, 40(8), 2911–2944.

Suwanwela, N. C., & Poungvarin, N. (2016). Stroke burden and stroke care system in Asia. Neurology India, 64(7), 46.

Teasell, R., Foley, N., Pereira, S., et al. (2012). Evidence to practice: Botulinum toxin in the treatment of spasticity post stroke. Topics in Stroke Rehabilitation, 19(2), 115–121.

Thompson, B. G., Brown, R. J., Amin-Hanjani, S., et al. (2015). Guidelines for the management of patients with unruptured intracranial aneurysms: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 46(8), 2368–2400.

Treat-Jacobson, D. J., Rich, K., DeVeaux, T., et al. (2013). Society for vascular nursing clinical practice guideline (CPG) for carotid artery stenting. Journal of Vascular Nursing, 31(1), 32–55.

Wijdicks, E. M., Sheth, K. N., Carter, B. S., et al. (2014). Recommendations for the management of cerebral and cerebellar infarction with swelling: A statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 45(4), 1222–1238.

*Wuchner, S., Bakas, T., Adams, G., et al. (2012). Nursing interventions and assessments for aneurysmal subarachnoid hemorrhage patients: A mixed methods study involving practicing nurses. Journal of Neuroscience Nursing, 44(4), 177–185.

Zanichkowsky, R., Nascimento, J. A., McCune, M., et al. (2016). Where does the time go? The effect of protocols for stroke last known well documentation on intravenous recombinant tissue plasminogen activator delivery in the northeast. Journal of Neuroscience Nursing, 48(2), 71–74.

Zheng, L., & Alexander, S. A. (2015). Current evidence in the management of poststroke hemiplegic shoulder pain: A review. Journal of Neuroscience Nursing, 47(1), 10–19.

Resources

American Association of Neuroscience Nurses (AANN), www.aann.org

American Stroke Association, a Division of the American Heart Association, www.strokeassociation.org/STROKEORG/

Brain Attack Coalition, www.brainattackcoalition.org

National Institute of Neurological Disorders and Stroke, www.ninds.nih.gov

National Stroke Association, www.stroke.org

CHAPTER 51

Management of Patients with Neurologic Trauma

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe the mechanisms of injury, clinical signs and symptoms, diagnostic testing, and treatment options for patients with traumatic brain and spinal cord injuries.
2. Use the nursing process as a framework for care of patients with traumatic brain injury.
3. Identify the population at risk for spinal cord injury.
4. Explain the clinical features and management of the patient with neurogenic shock.
5. Discuss the pathophysiology of autonomic dysreflexia and describe the appropriate nursing interventions.
6. Apply the nursing process as a framework for care of patients with spinal cord injury.
7. Explain the rehabilitation of patients following neurotrauma.

GLOSSARY

autonomic dysreflexia: a life-threatening emergency in patients with spinal cord injury that causes a hypertensive emergency; also called *autonomic hyperreflexia*

complete spinal cord lesion: a condition that involves total loss of sensation and voluntary muscle control below the lesion

concussion: a temporary loss of neurologic function with no apparent structural damage to the brain

contusion: bruising of the brain surface

halo vest: external traction device that encircles the head like a halo and stabilizes the cervical spine

incomplete spinal cord lesion: a condition in which there is preservation of the sensory or motor fibers, or both, below the lesion

neurogenic bladder: bladder dysfunction that results from a disorder or dysfunction of the nervous system; may result in either urinary retention or bladder overactivity

paraplegia: paralysis of the lower extremities with dysfunction of the bowel and bladder from a lesion in the thoracic, lumbar, or sacral region of the spinal cord

primary injury: initial damage to the brain that results from the traumatic event secondary injury; an insult to the brain subsequent to the original traumatic event

spinal cord injury (SCI): an injury to the spinal cord, vertebral column, supporting soft tissue, or intervertebral discs caused by trauma

tetraplegia: varying degrees of paralysis of both arms and legs, with dysfunction of bowel and bladder from a lesion of the cervical segments of the spinal cord; formerly called *quadriplegia*

transection: severing of the spinal cord itself; transection can be complete (all the way through the cord) or incomplete (partially through)

traumatic brain injury: an injury to the skull or brain that is severe enough to interfere with normal functioning

traumatic brain injury, closed (blunt): occurs when the head accelerates and then rapidly decelerates or collides with another object and brain tissue is damaged, but there is no opening through the skull and dura

traumatic brain injury, open (penetrating): occurs when an object penetrates the skull, enters the brain, and damages the soft brain tissue in its path (penetrating injury), or when blunt trauma to the head is so severe that it opens the scalp, skull, and dura to expose the brain

Introduction

Trauma involving the central nervous system can be life threatening. Even if not life threatening, brain and spinal cord injury (SCI) may result in major physical and psychological dysfunction and can alter the patient's life completely. Neurologic trauma affects the patient, the family, the health care system, and society as a whole because of its major sequelae and the costs of acute and long-term care of patients with trauma to the brain and spinal cord.

Head Injuries

Head injury is a broad classification that encompasses any damage to the head as a result of trauma. A head injury does not necessarily mean a brain injury is present. Traumatic brain injury (TBI) or craniocerebral trauma describes an injury that is the result of an external force and is of sufficient magnitude to interfere with daily life and prompts the seeking of treatment.

The Centers for Disease Control and Prevention (CDC) estimates that there are 2.5 million emergency department (ED) visits in the United States each year, the majority of which are for a mild TBI (CDC, 2016a). As a result of TBI, approximately 52,000 people die (contributing to about 30% of all injury-related deaths), 275,000 are hospitalized, and 80,000 to 90,000 will have long-term disabilities (CDC, 2016a); (Hickey, 2014). Approximately 78% of patients are treated in the ED and released (Hemphill & Phan, 2016). The most common causes of TBIs are falls (35.2%), motor vehicle crashes (17.3%), being struck by objects (16.5%), and assaults (10%). Children 0 to 4 years, adolescents 15 to 19 years, and adults 65 years and older are most likely to sustain a TBI. In every age group, TBI rates are higher for males than for females (Hickey, 2014). An estimated 57 million people worldwide are currently living with a TBI-related disability, producing an annual economic impact of approximately $60 to $75 billion due to medical expenses and the cost of lost productivity (CDC, 2016a). The best approach to head injury is prevention (see Chart 51-1).

Chart 51-1 HEALTH PROMOTION

Preventing Head and Spinal Cord Injuries

- Advise drivers to obey traffic laws and to avoid speeding or driving when under the influence of drugs or alcohol.
- Advise all drivers and passengers to wear seat belts and shoulder harnesses. Children younger than 12 years should use an age/size-appropriate system in the back seat.
- Caution passengers against riding in the back of pickup trucks.
- Advise motorcyclists, scooter riders, bicyclists, skateboarders, and roller skaters to wear helmets.
- Promote educational programs that are directed toward violence and suicide prevention in the community.
- Provide water safety instruction.
- Educate patients about steps that can be taken to prevent falls, particularly in older adults.
- Advise athletes to use protective devices. Recommend that coaches be educated in proper coaching techniques.
- Advise owners of firearms to keep them locked in a secure area where children cannot access them.

India is the seventh largest country by area and the second most populous country. The Ministry of Road Transport, Government of India, statistics (2020) show that 4,49,002 road traffic accidents occurred in 2019 and 3,66,138 accidents occurred in 2020 in various states and union territories of India. The percentage of fatal accidents was 33.7 in 2019 and 36 in 2020. The state of Tamil Nadu stands first in the number of road traffic accident (Government of India, 2020).

Pathophysiology

Research suggests that not all brain damage occurs at the moment of impact. Damage to the brain from traumatic injury takes two forms: primary injury and secondary injury. Primary injury is defined as the consequence of direct contact to the head/brain during the instant of initial injury, causing extracranial focal injuries (e.g., contusions, lacerations, external hematomas, and skull fractures), as well as possible focal brain injuries from sudden movement of the brain within the cranial vault (e.g., subdural hematomas (SDHs), concussion, diffuse axonal injury [DAI]). The greatest opportunity for decreasing TBI is the implementation of prevention strategies (see Chart 51-1).

Secondary injury evolves over the ensuing hours and days after the initial injury and results from inadequate delivery of nutrients and oxygen to the cells. Identification, prevention, and treatment of secondary injury are the main foci of early management of severe TBI. Contributors to this process include intracranial pathologic processes such as intracranial hemorrhage, cerebral edema, intracranial hypertension, hyperemia, seizures, and vasospasm (Bader, Littlejohns, & Olson, 2016); (Hickey, 2014). Systemic effects from hypotension, hyperthermia, hypoxia, hypercarbia, infection, electrolyte imbalances, and anemia can also be factors which add to the complex biochemical, metabolic, and inflammatory changes that further compromise an injured brain (Bader et al., 2016); (Hickey, 2014).

The Monro–Kellie hypothesis, also known as the Monro–Kellie doctrine, explains the dynamic equilibrium of cranial contents. The cranial vault contains three main components: brain, blood, and cerebrospinal fluid (CSF). According to the Monro–Kellie hypothesis, the cranial vault is a closed system, and if one of the three components increases in volume, at least one of the other two must decrease in volume or the pressure will increase. Any bleeding or swelling within the skull

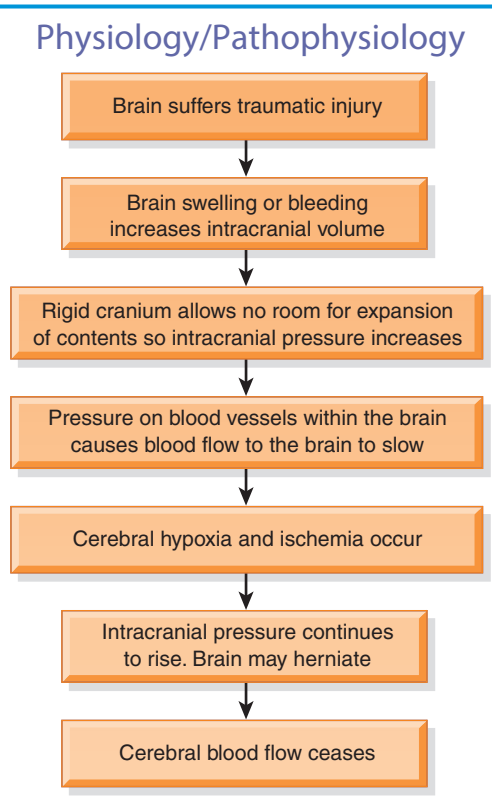


Figure 51-1 • Pathophysiology of traumatic brain injury.

increases the volume of contents within the skull and therefore causes increased intracranial pressure (ICP) (see Chapter 49). If the pressure increases enough, it can cause displacement of the brain through or against the rigid structures of the skull. This causes restriction of blood flow to the brain, decreasing oxygen delivery and waste removal. Cells within the brain become anoxic and cannot metabolize properly, producing ischemia, infarction, irreversible brain damage, and eventually brain death (see Fig. 51-1).

Scalp Injury

Isolated scalp trauma is generally classified as a minor injury. Because its many blood vessels constrict poorly, the scalp bleeds profusely when injured. Trauma may result in an abrasion (brush wound), contusion, laceration, or hematoma beneath the layers of tissue of the scalp (subgaleal hematoma) (Hickey, 2014). A large avulsion (tearing away) of the scalp may be potentially life threatening and is a true emergency. Diagnosis of a scalp injury is based on physical examination, inspection, and palpation. Scalp wounds are potential portals of entry for organisms that cause intracranial infections. Therefore, the area is irrigated before the laceration is sutured to remove foreign material and to reduce the risk for infection (Hollander & Camacho, 2014). Subgaleal hematomas (hematomas below the outer covering of the skull) usually reabsorb and do not require any specific treatment.

Skull Fractures

A skull fracture is a break in the continuity of the skull caused by forceful trauma. It may occur with or without damage to the brain. Skull fractures are classified by type and location. Types include linear, comminuted, and depressed skull fractures, whereas location fractures include frontal, temporal, and basal skull fractures. A simple (linear) fracture is a break in the

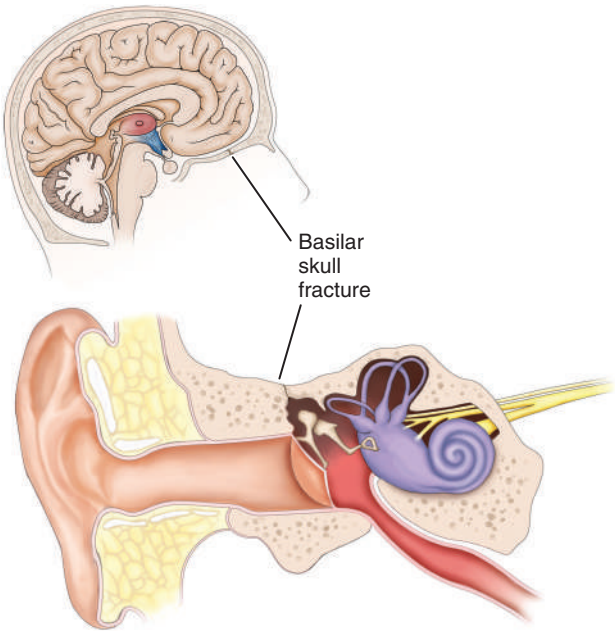


Figure 51-2 • Basal skull fracture allows cerebrospinal fluid to leak from the nose and ears. Adapted from Hickey, J. V. (2009). The clinical practice of neurological & neurosurgical nursing (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

continuity of the bone. A comminuted skull fracture refers to a splintered or multiple fracture line. Depressed skull fractures occur when the bones of the skull are forcefully displaced downward, and can vary from a slight depression to bones of the skull being splintered and embedded within brain tissue. A fracture of the base of the skull is referred to as a basal skull fracture (Hickey, 2014) (see Fig. 51-2). A fracture may be open, indicating a scalp laceration or tear in the dura (e.g., from a bullet or an ice pick), or closed, in which case the dura is intact.

Clinical Manifestations

Symptoms, apart from those of the local injury, depend on the severity and the anatomic location of the underlying brain injury. Persistent, localized pain usually suggests that a fracture is present. Fractures of the cranial vault may or may not produce swelling in the region of the fracture. Fractures of the base of the skull tend to traverse the paranasal sinus of the frontal bone or the middle ear located in the temporal bone (see Fig. 51-2). Therefore, they frequently produce hemorrhage from the nose, pharynx, or ears, and blood may appear under the conjunctiva. An area of ecchymosis (bruising) may be seen over the mastoid (Battle sign). Basal skull fractures are suspected when CSF escapes from the ears (CSF otorrhea) and the nose (CSF rhinorrhea). Drainage of CSF is a serious problem, because meningeal infection can occur if organisms gain access to the cranial contents via the nose, ear, or sinus through a tear in the dura.

Assessment and Diagnostic Findings

A computed tomography (CT) scan can be used to diagnose a skull fracture. The ease with which a diagnosis of skull fracture is made depends on the site of the fracture. If a fracture is found on CT scan, there is always the question of associated brain injury, and a magnetic resonance imaging (MRI) scan provides better resolution and clearer pictures of the injured area (Hickey, 2014).

Gerontologic Considerations

Older patients with head injuries differ from those who are younger in terms of etiology of injury, higher mortality rates, longer lengths of hospital stay, and poorer functional outcomes. Neurologic assessment can be challenging, as the older adult patient with a TBI can have hearing and/or visual deficits or pre-existing dementia or cognitive issues, making establishment of a neurologic baseline difficult. The most common causes of injury in older adult patients are falls and motor vehicle crashes (Stocchetti & Maas, 2014). Approximately 61% of all TBIs among adults aged 65 years and older result from falls (CDC, 2016a). Physiologic changes related to aging may place the older adult at increased risk for injury, alter the type and severity of injury that occurs, or lead to complications. Two major factors place older adults at increased risk for hematomas. First, brain weight decreases, the dura becomes more adherent to the skull, and reaction times slow with increasing age (Eliopoulos, 2018). Second, many older adults take aspirin and anticoagulant agents as part of routine management of chronic conditions.

Medical Management

Nondepressed skull fractures generally do not require surgical treatment; however, close observation of the patient is essential. Nursing personnel may observe the patient in the hospital, but if no underlying brain injury is present, the patient may be allowed to return home. If the patient is discharged home, specific instructions must be given to the family (see later discussion of concussion).

Depressed skull fractures usually require surgery with elevation of the skull and débridement, usually within 24 hours of injury. Skull fractures can be a combination of open, compound, closed, or simple. Associated injuries include concurrent scalp laceration, dural tears, and brain injury directly below the fracture from compression of the tissue below the bony injury and from lacerations produced by the bony fragments (Hickey, 2014).

Brain Injury

The most important consideration in any head injury is whether the brain is injured. Even seemingly minor injury can cause significant brain damage secondary to obstructed blood flow and decreased tissue perfusion. The brain cannot store oxygen or glucose to any significant degree. Because the cerebral cells need an uninterrupted blood supply to obtain these nutrients, irreversible brain damage and cell death occur if the blood supply is interrupted for even a few minutes. A traumatic brain injury, closed (blunt) occurs when the head accelerates and then rapidly decelerates or collides with another object (e.g., a wall, the dashboard of a car) and brain tissue is damaged but there is no opening through the skull and dura. A traumatic brain injury, open (penetrating) occurs when an object penetrates the skull, enters the brain, and damages the soft brain tissue in its path or when blunt trauma to the head is so severe that it opens the scalp, skull, and dura to expose the brain.

Types of Brain Injury

Injuries to the brain can be focal or diffuse. Focal injuries include contusions and several types of hematomas. Concussions and diffuse axonal injuries are the major diffuse injuries (Hickey, 2014).

Contusion

In cerebral contusion, the brain is bruised and damaged in a specific area because of severe acceleration–deceleration force or blunt trauma. The impact of the brain against the skull leads to a contusion. Clinical manifestations of a contusion are dependent upon size, location, and the extent of surrounding cerebral edema. Although a contusion may occur in any area of the brain, most are usually located in the anterior portions of the frontal and temporal lobes, around the Sylvian fissure, and at the orbital areas; less commonly, contusions are located at the parietal and occipital areas.

Contusions can be characterized by loss of consciousness associated with stupor and confusion. The effects of injury, particularly hemorrhage and edema, peak after about 18 to 36 hours. These effects, which can cause secondary effects resulting in increased ICP and possible herniation syndromes, are most pronounced in temporal lobe contusions. Patients are most often managed medically with interventions directed toward prevention of additional insults. Deep contusions are more often associated with hemorrhage and destruction of the reticular activating fibers, altering arousal (Hickey, 2014).

Intracranial Hemorrhage

Hematomas are collections of blood in the brain that may be epidural (above the dura), subdural (below the dura), or intracerebral (within the brain) (see Fig. 51-3). Major symptoms are frequently delayed until the hematoma is large enough to cause distortion of the brain and increased ICP. The signs and symptoms of cerebral ischemia resulting from compression by a hematoma are variable and depend on the speed with which vital areas are affected and the area that is injured. A rapidly developing hematoma, even if small, may be fatal, whereas a larger but slowly developing one may allow compensation for increases in ICP.

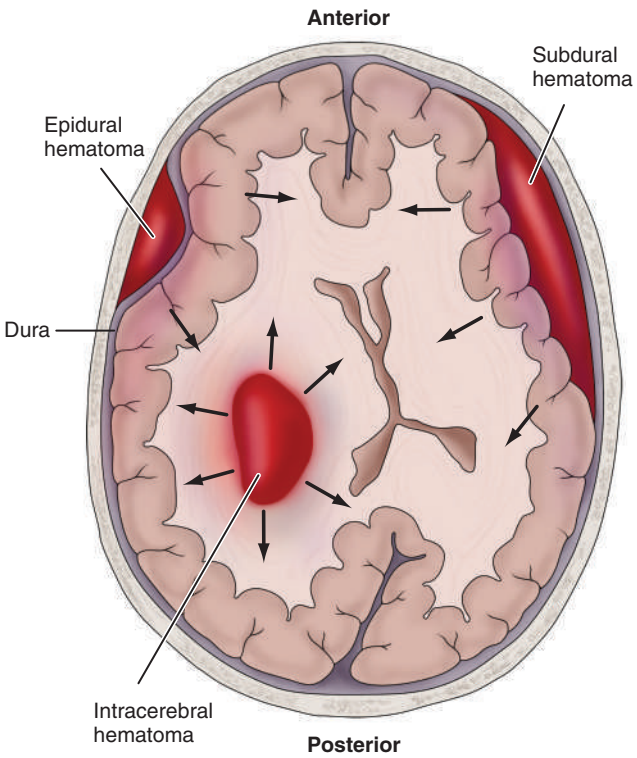


Figure 51-3 • Location of epidural, subdural, and intracerebral hematomas.

Epidural Hematoma

After a head injury, blood may collect in the epidural (extradural) space between the skull and the dura mater. This can result from a skull fracture that causes a rupture or laceration of the middle meningeal artery, the artery that runs between the dura and the skull inferior to a thin portion of temporal bone. Hemorrhage from this artery causes rapid pressure on the brain. Epidural hematomas (EDHs) account for approximately 2.7% to 4% of traumatic head injuries (Hickey, 2014).

Symptoms are caused by the expanding hematoma. EDHs are often characterized by a brief loss of consciousness, followed by a lucid interval in which the patient is awake and conversant. During this lucid interval, compensation for the expanding hematoma takes place by rapid absorption of CSF and decreased intravascular volume, both of which help to maintain the ICP within normal limits. When these mechanisms can no longer compensate, even a small increase in the volume of the blood clot produces a marked elevation in ICP. The patient then becomes increasingly restless, agitated, and confused as the condition progresses to coma. Then, often suddenly, signs of herniation appear (usually deterioration of consciousness and signs of focal neurologic deficits, such as dilation and fixation of a pupil or paralysis of an extremity), and the patient's condition deteriorates rapidly. The most common type of herniation syndrome associated with an EDH is uncal herniation causing pressure on the midbrain (Hickey, 2014).

An EDH is considered an extreme emergency; marked neurologic deficit or even respiratory arrest can occur within minutes. Treatment consists of making openings through the skull (burr holes; see Chapter 49, Fig. 49-10) to decrease ICP emergently, remove the clot, and control the bleeding. A craniotomy may be required to remove the clot and control the bleeding. A drain is usually inserted after creation of burr holes or a craniotomy to prevent reaccumulation of blood.

Subdural Hematoma

An SDH is a collection of blood between the dura and the brain, a space normally occupied by a thin cushion of fluid. The most common cause is trauma, but it can also occur as a result of coagulopathies or rupture of an aneurysm. An SDH is more frequently venous in origin and is caused by the rupture of small vessels that bridge the subdural space (Bauman & McCourt, 2014). SDHs may be acute or chronic depending on the size of the involved vessel and the amount of bleeding on CT scan.

Acute SDH

Approximately 50% of brain injuries and 60% of deaths in patients with brain injuries result from acute SDHs and are associated with major head injury involving contusion or laceration. Clinical symptoms develop rapidly (Bauman & McCourt, 2014). Signs and symptoms include changes in the level of consciousness (LOC), pupillary signs, and hemiparesis. There may be minor or even no symptoms with small collections of blood. Coma, increasing blood pressure, decreasing heart rate, and slowing respiratory rate are all signs of a rapidly expanding mass requiring immediate intervention.

If the patient can be transported rapidly to the hospital, an immediate craniotomy is performed to open the dura, allowing the subdural clot to be evacuated. Successful outcome also depends on the control of ICP and careful monitoring of

respiratory function (see Chapter 49). The mortality rate for patients with acute SDH is high because of associated brain damage (Bauman & McCourt, 2014).

Chronic SDH

A chronic SDH can develop from seemingly minor head injuries and is seen most frequently in older adults who are prone to this type of head injury due to brain atrophy, which is a consequence of the aging process (Bauman & McCourt, 2014). Seemingly minor head trauma may produce enough impact to shift the brain contents abnormally. The time between injury and onset of symptoms can be lengthy (e.g., 3 weeks to months), so the actual injury may be forgotten.

A chronic SDH can resemble other conditions—for example, it may be mistaken for a stroke. The bleeding is less profuse, but compression of the intracranial contents still occurs. The blood within the brain changes in character in 2 to 4 days, becoming thicker and darker. In a few weeks, the clot breaks down and has the color and consistency of motor oil. Eventually, calcification or ossification of the clot takes place. The brain adapts to this foreign body invasion, and the clinical signs and symptoms fluctuate. Symptoms include severe headache, which tends to come and go; alternating focal neurologic signs; personality changes; mental deterioration; and focal seizures (Bauman & McCourt, 2014).

The treatment for a chronic SDH consists of surgical evaluation for evacuation of the clot. Consideration must be made for reversal of coagulopathies and iatrogenic anticoagulation (Bauman & McCourt, 2014). The operative procedure may be carried out through multiple burr holes, or a craniotomy may be performed for a sizable subdural mass that cannot be suctioned or drained through burr holes.

Intracerebral Hemorrhage and Hematoma

Intracerebral hemorrhage is bleeding into the parenchyma of the brain. It is commonly seen in head injuries when force is exerted to the head over a small area (e.g., missile injuries, bullet wounds, stab injuries). These hemorrhages within the brain may also result from the following:

- Systemic hypertension, which causes degeneration and rupture of a vessel
- Rupture of an aneurysm
- Vascular anomalies
- Intracranial tumors
- Bleeding disorders such as leukemia, hemophilia, aplastic anemia, and thrombocytopenia
- Complications of anticoagulant therapy

Nontraumatic causes of intracerebral hemorrhage are discussed in Chapter 50.

The onset may be insidious, beginning with the development of neurologic deficits, followed by headache. Management includes supportive care; control of ICP; and careful administration of fluids, electrolytes, and antihypertensive medications. Surgical intervention by craniotomy or craniectomy permits removal of the blood clot and control of hemorrhage, but may not be possible because of the inaccessible location of the bleeding or the lack of a clearly circumscribed area of blood that can be removed.

Concussion

A concussion is a temporary loss of neurologic function with no apparent structural damage to the brain. Of the 1.7 million TBIs that occur in the United States each year, it is estimated that approximately 80% of them are concussions, also referred to as "mild TBI" (Hyatt, 2014); (CDC, 2016b). The mechanism of injury is usually blunt trauma from an acceleration–deceleration force, a direct blow, or a blast injury. If brain tissue in the frontal lobe is affected, the patient may exhibit bizarre irrational behavior, whereas involvement of the temporal lobe can produce temporary amnesia or disorientation.

The duration of mental status abnormalities is an indicator of the grade of the concussion. The patient is discharged from the hospital or ED once he or she returns to baseline after a concussion. Monitoring includes observing the patient for a decrease in LOC, worsening headache, dizziness, seizures, abnormal pupil response, vomiting, irritability, slurred speech, and numbness or weakness in the arms or legs (West, Bergman, Biggins, et al., 2011). The occurrence of these symptoms is a red flag indicating the need for further intervention. Recovery may appear complete, but long-term sequelae are possible and repeat injuries common.

Repeated concussive incidents can lead to a syndrome known as chronic traumatic encephalopathy. This syndrome has been recognized in those participating in contact sports such as football and boxing. The presentation is similar to Alzheimer disease, characterized by personality changes, memory impairment, and speech and gait disturbances. Imaging findings show gross cerebral, particularly temporal lobe, atrophy (Bailes, Petraglia, Omalu, et al., 2013); (Hickey, 2014).

Diffuse Axonal Injury

DAI results from widespread shearing and rotational forces that produce damage throughout the brain—to axons in the cerebral hemispheres, corpus callosum, and brainstem. The injured area may be diffuse with no identifiable focal lesion. DAI is associated with prolonged traumatic coma; it is more serious and is associated with a poorer prognosis than a focal lesion. The patient with DAI in severe head trauma experiences no lucid interval, immediate coma, decorticate and decerebrate posturing (see Chapter 49, Fig. 49-2), and global cerebral edema. Diagnosis is made by clinical signs in conjunction with a CT or MRI scan (Bodanapally, Sours, Zhuo, et al., 2015). Recovery depends on the severity of the axonal injury.

Medical Management

Assessment and diagnosis of the extent of injury are accomplished by the initial physical and neurologic examinations. CT and MRI scans are the main neuroimaging diagnostic tools and are useful in evaluating the brain structure (Bodanapally et al., 2015). Positron emission tomography (PET) is available in some trauma centers for assessing brain function.

Any patient with a head injury is presumed to have a cervical spine injury until proven otherwise. The patient is transported from the scene of the injury on a board with the head and neck maintained in alignment with the axis of the body. A cervical collar should be applied and maintained until cervical spine x-rays have been obtained and the absence of cervical SCI documented.

All therapy is directed toward preserving brain homeostasis and preventing secondary brain injury, which is injury to the brain that occurs after the original traumatic event (Bader et al., 2016). Common causes of secondary injury are cerebral edema, hypotension, and respiratory depression that may lead to hypoxemia and electrolyte imbalance. Treatments to prevent secondary injury include stabilization of cardiovascular and respiratory function to maintain adequate cerebral perfusion, control of hemorrhage and hypovolemia, and maintenance of optimal blood gas values.

Treatment of Increased Intracranial Pressure

As the damaged brain swells with edema or as blood collects within the brain, an increase in ICP occurs; this requires aggressive treatment (see Chapter 49 for a discussion of the relationship between ICP and cerebral perfusion pressure [CPP]). If the ICP remains elevated, it can decrease the CPP. Initial management is based on preventing secondary injury and maintaining adequate cerebral oxygenation.

Surgery is required for evacuation of blood clots, débridement and elevation of depressed fractures of the skull, and suture of severe scalp lacerations. ICP is monitored closely; if increased, it is managed by maintaining adequate oxygenation, elevating the head of the bed, and maintaining normal blood volume (Stocchetti & Maas, 2014). Devices to monitor ICP or drain CSF can be inserted during surgery or at the bedside using aseptic technique. The patient is cared for in the intensive care unit (ICU), where expert nursing care and medical treatment are readily available.

Supportive Measures

Treatment also includes ventilatory support, seizure prevention, fluid and electrolyte maintenance, nutritional support, and management of pain and anxiety. Patients who are comatose are intubated and mechanically ventilated to ensure adequate oxygenation and protect the airway.

Because seizures can occur after head injury and can cause secondary brain damage from hypoxia, anticonvulsant agents may be given. If the patient is very agitated, benzodiazepines are the most commonly used sedative agents and do not affect cerebral blood flow or ICP. Lorazepam (Ativan) and midazolam (Versed) are frequently used but have active metabolites that may cause prolonged sedation, making it difficult to conduct a neurologic assessment. Propofol (Diprivan), a sedative–hypnotic agent that is supplied in an intralipid emulsion for intravenous (IV) use, is the sedative of choice. It is an ultra-short acting, rapid onset drug with elimination half-life of less than an hour. It has a major advantage of being titratable to its desired clinical effect but still provides the opportunity for an accurate neurologic assessment (Hickey, 2014). A nasogastric tube may be inserted, because reduced gastric motility and reverse peristalsis are associated with head injury, making regurgitation and aspiration common in the first few hours.

Brain Death

When a patient has sustained a severe head injury incompatible with life, the patient is a potential organ donor. The nurse may assist in the clinical examination for determination of brain death and in the process of organ procurement. The three cardinal signs of brain death on clinical examination are coma, the absence of brainstem reflexes, and apnea. Adjunctive tests, such as cerebral blood flow studies, electroencephalogram (EEG), transcranial Doppler, and brainstem auditory-evoked potential, are often used to confirm brain death (Hickey, 2014). The health care team provides information to the family and assists them with the decision-making process about end-of-life care.

NURSING PROCESS

The Patient with a Traumatic Brain Injury

Assessment

Depending on the patient's neurologic status, the nurse may elicit information from the patient, from the family, or from witnesses or emergency rescue personnel. Although all usual baseline data may not be collected initially, the immediate health history should include the following questions:

- When did the injury occur?
- What caused the injury? A high-velocity missile? An object striking the head? A fall?
- What was the direction and force of the blow?

A history of unconsciousness or amnesia after a head injury indicates a significant degree of brain damage, and changes that occur minutes to hours after the initial injury can reflect recovery or indicate the development of secondary brain damage. The nurse should determine if there was a loss of consciousness, the duration of the unconscious period, and if the patient could be aroused.

In addition to asking questions that establish the nature of the injury and the patient's condition immediately after the injury, the nurse examines the patient thoroughly. This assessment includes determining the patient's LOC using the Glasgow Coma Scale (GCS) and assessing the patient's response to tactile stimuli (if unconscious), pupillary response to light, corneal and gag reflexes, and motor function (Teasdale & Jennett, 1974). The GCS (see Chart 51-2) is based on the three criteria of eye opening, verbal responses, and motor responses to verbal commands or painful stimuli. It is particularly useful for monitoring changes during the acute phase, the first few days after a head injury. It does not take the place of an in-depth neurologic assessment.

Detailed assessments are made initially and at frequent intervals throughout the acute phase of care (Hickey, 2014). Monitoring of ICP is crucial to decision making for patients with neurologic injuries, yet research findings indicate that practices for the measurement of ICP vary widely (Olson, Rogers, & Stutzman, 2015) (see Chart 51-3). Baseline and ongoing assessments are critical in nursing assessment of the patient with brain injury, whose condition can worsen

Chart 51-2 ASSESSMENT

Glasgow Coma Scale

The Glasgow Coma Scale is a tool for assessing a patient's response to stimuli. Scores range from 3 (deep coma) to 15 (normal).

Eye-opening response	Spontaneous	4
	To voice	3
	To pain	2
	None	1
Best verbal response	Oriented	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	None	1
Best motor response	Obeys command	6
	Localizes pain	5
	Withdraws	4
	Flexion	3
	Extension	2
	None	1
Total		3 to 15

Adapted from Teasdale, G., & Jennett, B. (1974). Assessment of coma and impaired consciousness. A practical scale. Lancet, 2(7872), 81–84. Used with permission.

Chart 51-3 NURSING RESEARCH PROFILE

Validating the Electronic Medical Record for Measuring Increased Intracranial Pressure

Olson, D. M., Rogers, M. S., & Stutzman, S. (2015). Electronic medical record validation: Exploring the reliability of intracranial pressure data abstracted from the electronic medical record-pilot. Journal of Nursing Measurement, 23(3), 532–540.

Purpose

The most reliable and valid methods of measuring and documenting intracranial pressure (ICP) monitoring for patients with neurologic injuries are not known. The purpose of this pilot study was to compare different methods of ICP monitoring.

Design

This was a nonrandomized, unblinded, observational study that compared three different technologies. The technologies for recording ICP included pen and paper (P&P), electronic medical record (EMR), and video data with continuous data acquisition (CDA).

Findings

Data were obtained from 11 patients who had ICP monitoring and 26 nurses who provided care to these patients. Patients' mean age was 50.7 years, 6 (54.4%) were female, and 8 (72.7%) were White (two Black, and one not declared). Patient diagnoses included subarachnoid hemorrhage (six), intracranial hemorrhage (two), neoplasm (two), and one patient with cerebral edema following ischemic stroke. Nurses were primarily baccalaureate prepared (*n* 22, 84.6%) with a mean of 8.3 (*SD* 9.8) years of nursing experience and 7.5 (*SD* 1.7) years of experience in critical care. ICP values did not significantly differ between EMR and P&P records, despite an average of 16 minutes' difference in reporting times. ICP values did vary significantly when comparing CDA data to EMR or paper.

Nursing Implications

This pilot study called into question the validity of ICP values as they are currently recorded. Nurses caring for patients with neurologic injuries need to know that significant practice variation exists and there are no best practice standards for recording ICP. With EMRs becoming pervasive, more nursing research is essential in this area.

dramatically and irrevocably if subtle signs are overlooked (Arciniegas, Zasler, Vanderploeg, et al., 2013); (Booker, 2015). More information on assessment is provided in the following sections and in Figure 51-4 and Table 51-1.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Ineffective airway clearance and impaired gas exchange related to brain injury
- Risk for ineffective cerebral tissue perfusion related to increased ICP, decreased CPP, and possible seizures
- Deficient fluid volume related to decreased LOC and hormonal dysfunction
- Imbalanced nutrition: less than body requirements related to increased metabolic demands, fluid restriction, and inadequate intake
- Risk for injury (self-directed and directed at others) related to seizures, disorientation, restlessness, or brain damage
- Risk for imbalanced body temperature related to damaged temperature-regulating mechanisms in the brain
- Risk for impaired skin integrity related to bed rest, hemiparesis, hemiplegia, immobility, or restlessness
- Ineffective coping related to brain injury
- Disturbed sleep pattern related to brain injury and frequent neurologic checks
- Risk for dysfunctional family processes related to unresponsiveness of patient, unpredictability of outcome, prolonged recovery period, and the patient's residual physical disability and emotional deficit
- Deficient knowledge about brain injury, recovery, and the rehabilitation process

The nursing diagnoses for the patient who is unconscious and the patient with increased ICP also apply (see Chapter 49).

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Decreased cerebral perfusion
- Cerebral edema and herniation
- Impaired oxygenation and ventilation
- Impaired fluid, electrolyte, and nutritional balance
- Risk of posttraumatic seizures

Planning and Goals

The goals for the patient may include maintenance of a patent airway, adequate CPP, fluid and electrolyte balance, adequate nutritional status, prevention of secondary injury, maintenance of body temperature within normal limits, maintenance of skin integrity, improvement of coping, prevention of sleep deprivation, effective family coping, increased knowledge about the rehabilitation process, and absence of complications.

Nursing Interventions

The nursing interventions for the patient with a TBI are extensive and diverse. They include making nursing assessments, setting priorities for nursing interventions, anticipating needs and complications, and initiating rehabilitation.

Maintaining the Airway

One of the most important nursing goals in the management of head injury is to establish and maintain an adequate airway. The brain is extremely sensitive to hypoxia, and a neurologic deficit can worsen if the patient is hypoxic. Therapy is directed toward maintaining optimal oxygenation to preserve cerebral function. An obstructed airway causes carbon dioxide retention and hypoventilation, which can produce cerebral vessel dilation and increased ICP (McNett & Olson, 2013); (Mitchell, Kirkness, & Blissitt, 2015).

Interventions to ensure an adequate exchange of air are discussed in Chapter 49 and include the following:

- Maintaining the patient who is unconscious in a position that facilitates drainage of oral secretions, with the head of the bed elevated about 30 degrees to decrease intracranial venous pressure
- Establishing effective suctioning procedures (pulmonary secretions produce coughing and straining, which increase ICP)
- Guarding against aspiration and respiratory insufficiency



Figure 51-4 • Assessment parameters for the patient with a head injury include eye opening and responsiveness (**A**), vital signs (**B**), and motor response reflected in hand strength or response to painful stimulus (**C**, **D**). Photos by B. Proud.

TABLE 51-1 Multisystem Assessment Measures for the Patient with Traumatic Brain Injury

System-Specific Considerations	Assessment Data
Neurologic System	
• Severe TBI results in unconsciousness and alters many neurologic functions. • All body functions must be supported. • Increased ICP and herniation syndromes are life threatening. • Measures are instituted to control elevated ICP.	• Assessment of neurologic status • Assessment for signs and symptoms of ICP elevation • Calculation of cerebral perfusion pressure if ICP monitor is in place • Monitoring of anticonvulsant medication blood levels
Integumentary System (Skin and Mucous Membranes)	
• Immobility secondary to TBI and unconsciousness contributes to the development of pressure areas and skin breakdown. • Intubation causes irritation of the mucous membrane and deterioration of oral health.	• Assessment of skin integrity and character of the skin • Assessment of oral mucous membrane and oral health
Musculoskeletal System	
• Immobility contributes to musculoskeletal changes. • Decerebrate or decorticate posturing makes proper positioning difficult.	• Assessment of range of motion of joints and development of deformities or spasticity
Gastrointestinal System	
• Injury to the GI tract can result in paralytic ileus. • Constipation can result from bed rest, NPO status, fluid restriction, and opioids given for pain control. • Bowel incontinence is related to the patient's unconscious state or altered mental state.	• Assessment of abdomen for bowel sounds and distention • Monitoring for decreased hemoglobin
Genitourinary System	
• Fluid restriction or the use of diuretic agents can alter the amount of urinary output. • Urinary incontinence is related to the patient's unconscious state.	• Intake and output record

(*Continued*)

(*Continued*)

Metabolic (Nutritional) System	
• The patient receives all fluids IV for the first few days until the GI tract is functioning. • A nutritional consultation is initiated within the first 24–48 hours; parenteral or enteral nutrition may be started.	• Assessment of fluid and electrolyte balance • Recording of weight, if possible • Hematocrit • Electrolyte studies
Respiratory System	
• Complete or partial airway obstruction will compromise the oxygen supply to the brain. • An altered respiratory pattern can result in cerebral hypoxia. • A short period of apnea at the moment of impact can result in spotty atelectasis. • Systemic disturbances from head injury can cause hypoxemia. • Brain injury can alter brainstem respiratory function. • Shunting of blood to the lungs as a result of a sympathetic discharge at the time of injury can cause neurogenic pulmonary edema.	• Assessment of respiratory function: – Auscultate chest for breath sounds – Note the respiratory pattern, if possible (not possible if a ventilator is being used) – Note the respiratory rate – Note whether the cough reflex is intact • Arterial blood gas levels • Complete blood count • Chest x-ray studies • Sputum cultures • Oxygen saturation using pulse oximetry
Cardiovascular System	
• The patient may develop cardiac dysrhythmias, tachycardia, or bradycardia. • The patient may develop hypotension or hypertension. • Because of immobility and unconsciousness, the patient is at high risk for DVT and PE. • Fluid and electrolyte imbalance can be related to several problems, including alterations in antidiuretic hormone secretion, the stress response, or fluid restriction. • Specific conditions may occur: – Diabetes insipidus – Syndrome of inappropriate secretion of antidiuretic hormone – Electrolyte imbalance – Hyperglycemic hyperosmolar syndrome	• Assessment of vital signs • Monitoring for cardiac dysrhythmias • Assessment for venous thromboembolism including PE and DVT • Electrocardiogram • Electrolyte studies • Blood coagulation studies • Blood glucose level • Blood acetone level • Blood osmolality • Urine-specific gravity
Psychological/Emotional Response	
• The patient with TBI is unconscious. • The family needs emotional support to deal with the crisis.	• Alternative methods of assessment for pain are indicated in the patient who is unconscious (see Chapter 48, Chart 48-2) • Collection of information about the family and the role within the family of the person with head injury • Assessment of the family to determine how functional it was before the injury occurred

DVT, deep vein thrombosis; GI, gastrointestinal; ICP, intracranial pressure; IV, intravenous; NPO, nothing by mouth; PE, pulmonary embolism; TBI, traumatic brain injury.
Adapted from Booker, K. (2015). Critical care nursing: Monitoring and treatment for advanced nursing practice. Oxford: Wiley Blackwell.

- Closely monitoring arterial blood gas values to assess the adequacy of ventilation. The goal is to keep blood gas values within normal limits to ensure adequate cerebral blood flow.
- Monitoring the patient who is receiving mechanical ventilation for pulmonary complications such as acute respiratory distress syndrome and pneumonia (Hickey, 2014)

The patient who is intubated is at high risk for ventilator-associated pneumonia, and providing good oral hygiene can help prevent this complication (Larrow & Klich-Heartt, 2016).

Monitoring Neurologic Function

Patients with severe TBI are admitted to the ICU for close assessment and monitoring (cardiac monitoring, pulse oximetry, invasive arterial blood pressure monitoring, end-tidal CO_2, and temperature monitoring). Parameters are assessed initially and as frequently as the patient's condition requires. As soon as the initial assessment is made, the use of a neurologic observational flow record is started and maintained.

The importance of ongoing assessment and monitoring of the patient with brain injury cannot be overstated.

Level of Consciousness. The GCS is used to assess LOC at regular intervals, because changes in the LOC precede all other changes in vital and neurologic signs. The patient's best responses to predetermined stimuli are recorded (see Chart 51-2). Each response is scored (the greater the number, the better the functioning), and the sum of these scores gives an indication of the severity of coma and a prediction of possible outcome. The lowest score is 3 (least responsive); the highest is 15 (most responsive). A GCS score between 3 and 8 is generally accepted as indicating a severe head injury (Bader et al., 2016).

Nursing Alert: The GCS is considered the most sensitive indicator of a lapse in neurologic functioning in patients with TBI and is often the earliest sign of acute change in ICP.

Vital Signs. Although a change in LOC is the most sensitive neurologic indication of deterioration of the patient's condition, vital signs also are monitored at frequent intervals to assess the intracranial status. Table 51-1 depicts the general assessment parameters for the patient with a head injury.

Signs of increasing ICP include slowing of the heart rate (bradycardia), increasing systolic blood pressure, and widening

pulse pressure (Cushing reflex). As brain compression increases, respirations become rapid, the blood pressure may decrease, and the pulse slows further. This is an ominous development, as is a rapid fluctuation of vital signs (Hickey, 2014). The temperature is maintained at less than 38°C (100.4°F) (Perez-Barcena, Llompart-Pou, & O'Phelan, 2014). Tachycardia and arterial hypotension may indicate that bleeding is occurring elsewhere in the body.

Nursing Alert: In a patient with a head injury, a rapid increase in body temperature is regarded as unfavorable because hyperthermia increases the metabolic demands of the brain and may indicate brainstem damage—a poor prognostic sign.

Motor Function. Motor function is assessed frequently by observing spontaneous movements, asking the patient to raise and lower the extremities, and comparing the strength and equality of the upper and lower extremities at periodic intervals. To assess upper extremity strength, the nurse instructs the patient to squeeze the examiner's fingers tightly. The nurse assesses lower extremity motor strength by placing the hands on the soles of the patient's feet and asking the patient to push down against the examiner's hands. Examination of the motor system is discussed in more detail in Chapter 48. The presence or absence of spontaneous movement of each extremity is also noted, and speech and eye signs are assessed.

If the patient does not demonstrate spontaneous movement, responses to painful stimuli are assessed (Hickey, 2014). Motor response to pain is assessed by applying a central stimulus, such as pinching the pectoralis major muscle, to determine the patient's best response. Peripheral stimulation may provide inaccurate assessment data because it may result in a reflex movement rather than a voluntary motor response. Abnormal responses (lack of motor response; extension responses) are associated with a poorer prognosis.

Other Neurologic Signs. In addition to the patient's spontaneous eye opening, which is evaluated with the GCS, the size and equality of the pupils and their reaction to light are assessed (Booker, 2015). A unilaterally dilated and poorly responding pupil may indicate a developing hematoma, with subsequent pressure on the third cranial nerve due to shifting of the brain. If both pupils become fixed and dilated, this indicates acute injury and intrinsic damage to the upper brainstem and is a poor prognostic sign (Bader et al., 2016).

The patient with a head injury may develop deficits such as anosmia (lack of sense of smell), eye movement abnormalities, aphasia, memory deficits, and posttraumatic seizures or epilepsy. Patients may be left with residual psychological deficits (impulsiveness; emotional lability; or uninhibited, aggressive behaviors) and, as a consequence of the impairment, may lack insight into their emotional responses.

Monitoring Fluid and Electrolyte Balance

Brain damage can produce metabolic and hormonal dysfunctions. The monitoring of serum electrolyte levels is important, especially in patients receiving osmotic diuretics, those with syndrome of inappropriate antidiuretic hormone (SIADH) secretion, and those with posttraumatic diabetes insipidus.

Serial studies of blood and urine electrolytes and osmolality are carried out because head injuries may be accompanied by disorders of sodium regulation. Hyponatremia is common after head injury due to shifts in extracellular fluid, electrolytes, and volume. Hyperglycemia, for example, can cause an increase in extracellular fluid that lowers sodium. Hypernatremia may also occur as a result of sodium retention that may last several days, followed by sodium diuresis. Increasing lethargy, confusion, and seizures may be the result of electrolyte imbalance.

Endocrine function is evaluated by monitoring serum electrolytes, blood glucose values, and intake and output. Urine is tested regularly for acetone. A record of daily weights is maintained, especially if the patient has hypothalamic involvement and is at risk for the development of diabetes insipidus.

Promoting Adequate Nutrition

Head injury results in metabolic changes that increase calorie consumption and nitrogen excretion. Protein demand increases. Early initiation of nutritional therapy has been shown to improve outcomes in patients with head injury. Patients with brain injury are assumed to be catabolic, and nutritional support consultation should be considered as soon as the patient is admitted. Parenteral nutrition via a central line or enteral feedings given via a nasogastric or nasojejunal feeding tube should be considered, though enteral is the preferred route (Hickey, 2014). If CSF rhinorrhea occurs or if there is any suspicion of disruption to the skull base, an oral feeding tube should be inserted instead of a nasal tube.

Laboratory values should be monitored closely in patients receiving parenteral nutrition. Elevating the head of the bed can help prevent distention, regurgitation, and aspiration. A continuous-drip infusion or pump may be used to regulate the feeding. Enteral or parenteral feedings are usually continued until the swallowing reflex returns and the patient can meet caloric requirements orally. See Chapter 15 for the principles and technique of enteral feedings.

Preventing Injury

Often, as the patient emerges from coma, a period of lethargy and stupor is followed by a period of agitation. Each phase is variable and depends on the person, the location of the injury, the depth and duration of coma, and the patient's age. Restlessness may be caused by hypoxia, fever, pain, or a full bladder. It may indicate injury to the brain but may also be a sign that the patient is regaining consciousness. (Some restlessness may be beneficial because the lungs and extremities are exercised.) Agitation may also be the result of discomfort from catheters, IV lines, restraints, and repeated neurologic checks. Alternatives to restraints must be used whenever possible.

Strategies to prevent injury include the following:

- Assessing the patient to ensure that oxygenation is adequate and the bladder is not distended. Dressings and casts are checked for constriction
- Using padded side rails or wrapping the patient's hands in mitts to protect the patient from self-injury and dislodging of tubes. Restraints are used judiciously, because straining against them can increase ICP or cause other injury. Enclosed or floor-level specialty beds may be indicated (see Chart 51-4)
- Avoiding opioids as a means of controlling restlessness, because they depress respiration, constrict the pupils, and alter responsiveness
- Reducing environmental stimuli by keeping the room quiet, limiting visitors, speaking calmly, and providing frequent orientation information (e.g., explaining where the patient is and what is being done)

Chart 51-4 ETHICAL DILEMMA

When is it Appropriate to Use Restraints?

Case Scenario

You work as a staff nurse on a rehabilitation unit. A 23-year-old man is admitted to the unit with a brain injury, which occurred as a result of a motorcycle crash. His severe brain injuries caused cerebral hypoxia and ischemia to occur. He has periods of severe agitation, has fallen out of bed twice, and an enclosed bed has been prescribed for his safety.

Discussion

Nurses must weigh carefully the risks of limiting autonomy and increasing the risks of injury by using restraints against the risks of injury if not using restraints, which have been documented as resulting in physical harm and death.

Analysis

- Describe the ethical principles that are in conflict in this case (see Chapter 2, Chart 2-3). Which principle should have pre-eminence when a treatment plan is devised for this patient?
- What are your professional obligations in this case? What steps might you take to ensure that the patient's autonomy is preserved?

Resources

See Chapter 2, Chart 2-6 for ethics resources.

- Providing adequate lighting to prevent visual hallucinations
- Minimizing disruption of the patient's sleep–wake cycles
- Lubricating the patient's skin with oil or emollient lotion to prevent irritation due to rubbing against the sheet
- Using an external sheath catheter for a male patient if incontinence occurs. Because prolonged use of an indwelling catheter inevitably produces infection, the patient may be placed on an intermittent catheterization schedule.

Maintaining Body Temperature

Fever in the patient with a TBI can be the result of damage to the hypothalamus, cerebral irritation from hemorrhage, or infection. The nurse monitors the patient's temperature every 2 to 4 hours. If the temperature increases, efforts are made to identify the cause and to control it using acetaminophen/paracetamol and cooling devices to maintain normothermia (Madden & DeVon, 2015); (Wilson & DellaPenna, 2015). Cooling devices should be used with caution so as not to induce shivering, which increases ICP. If infection is suspected, potential sites of infection are cultured and antibiotic agents are prescribed and given. Research about intentional hypothermia for patients with TBI suggests there is no clear evidence to guide therapy (Madden & DeVon, 2015); (Wilson & DellaPenna, 2015).

Maintaining Skin Integrity

Patients with TBI often require assistance in turning and positioning because of immobility or unconsciousness. Prolonged pressure on the tissues decreases circulation and leads to tissue necrosis. Potential areas of breakdown need to be identified early to avoid the development of pressure ulcers. Specific nursing measures include the following:

- Assessing all body surfaces and documenting skin integrity every 8 hours
- Turning and repositioning the patient every 2 hours (Larrow & Klich-Heartt, 2016)
- Providing skin care every 4 hours
- Assisting the patient to get out of bed to a chair three times a day

Improving Coping

Although many patients with head injury survive because of resuscitative and supportive technology, they frequently have ineffective coping due to cognitive sequelae. Cognitive impairment includes memory deficits; decreased ability to focus and sustain attention to a task (distractibility); impulsivity; egocentricity; and slowness in thinking, perceiving, communicating, reading, and writing. Psychiatric, emotional, and relationship problems develop in many patients after head injury. Resulting psychosocial, behavioral, emotional, and cognitive impairments are devastating to the family as well as to the patient (Tam, McKay, Sloan, et al., 2015).

These problems require collaboration among many disciplines. A neuropsychologist (specialist in evaluating and treating cognitive problems) plans a program and initiates therapy or counseling to help the patient reach maximal potential. Cognitive rehabilitation activities help the patient devise new problem-solving strategies. The retraining is carried out over an extended period and may include the use of sensory stimulation and reinforcement, behavior modification, reality orientation, computer training programs, and video games. Assistance from many disciplines is necessary during this phase of recovery. Even if intellectual ability does not improve, social and behavioral abilities may improve.

The patient recovering from a TBI may experience fluctuations in the level of cognitive function, with orientation, attention, and memory frequently affected. Many types of sensory stimulation programs have been tried, and research on these programs is ongoing (Hickey, 2014). When pushed to a level greater than the impaired cortical functioning allows, the patient may show symptoms of fatigue, anger, and stress (headache, dizziness). The Rancho Los Amigos Scale: Levels of Cognitive Functioning is frequently used to assess cognitive function and evaluate ongoing recovery from head injury. Progress through the levels of cognitive function can vary widely for individual patients (Hagen, Malkmus, & Durham, 1972). Nursing management and a description of each level are included in Table 51-2.

Preventing Sleep Pattern Disturbance

Patients who require frequent monitoring of neurologic status may experience sleep deprivation as they are awakened hourly for assessment of LOC. To allow the patient longer times of uninterrupted sleep and rest, the nurse can group nursing care activities so that the patient is disturbed less frequently. Environmental noise is decreased, and the room lights are dimmed. Measures to increase comfort may promote sleep and rest (Giusti, Tuteri, & Mirella, 2016).

Supporting Family Coping

Having a loved one sustain a TBI produces a great deal of stress in the family. This stress can result from the patient's physical and emotional deficits, the unpredictable outcome, and altered

TABLE 51-2 Rancho Los Amigos Scale: Levels of Cognitive Function

Cognitive Level	Description	Nursing Management
For levels I–III, the key approach is to *provide stimulation.*		
I: No response	Completely unresponsive to all stimuli, including painful stimuli	Multiple modalities of sensory input should be used. Examples are listed here, but management should be individualized and expanded based on available materials and patient preferences (determined by obtaining information from the family).
II: Generalized response	Nonpurposeful response; responds to pain but in a nonpurposeful manner	*Olfactory*: Perfumes, flowers, shaving lotion. *Visual*: Family pictures, card, personal items.
III: Localized response	Responses more focused—withdraws to pain; turns toward sound; follows moving objects that pass within visual field; pulls on sources of discomfort (e.g., tubes, restraints); may follow simple commands but inconsistently and in a delayed manner	*Auditory*: Radio, television, tapes of family voices or favorite recordings, talking to patient (nurse, family members). The nurse should tell patient what is going to be done, discuss the environment, provide encouragement. *Tactile*: Touching of skin, rubbing various textures on skin *Movement*: Range-of-motion exercises, turning, repositioning, the use of water mattress.
For levels IV–VI, the key approach is to *provide structure.*		
IV: Confused, agitated response	Alert, hyperactive state in which patient responds to internal confusion/agitation; behavior nonpurposeful in relation to the environment; aggressive, bizarre behavior common	For level IV, which lasts 2–4 weeks, interventions are directed at decreasing agitation, increasing environmental awareness, and promoting safety. • Approach patient in a calm manner, and use a soft voice. • Screen patient from environmental stimuli (e.g., sounds, sights); provide a quiet, controlled environment. • Remove devices that contribute to agitation (e.g., tubes), if possible. • Functional goals cannot be set because the patient is unable to cooperate.
V: Confused, inappropriate response	When agitation occurs, it is the result of external rather than internal stimuli; focused attention is difficult; memory is severely impaired; responses are fragmented and inappropriate to the situation; there is no carryover of learning from one situation to the other	For levels V and VI, interventions are directed at decreasing confusion, improving cognitive function, and improving independence in performing ADLs. • Provide supervision. • Use repetition and cues to educate about ADLs. Focus the patient's attention, and help to increase their concentration. • Help the patient organize activity. • Clarify misinformation and reorient when confused. • Provide a consistent, predictable schedule (e.g., post daily schedule on large poster board).
VI: Confused, appropriate response	Follows simple directions consistently but is inconsistently oriented to time and place; short-term memory worse than long-term memory; can perform some ADLs	
For levels VII–X, the key approach is *integration into the community.*		
VII: Automatic, appropriate response	Appropriately responsive and oriented within the hospital setting; needs little supervision in ADLs; some carryover of learning; patient has superficial insight into disabilities; has decreased judgment and problem-solving abilities; lacks realistic planning for future	For levels VII–X, interventions are directed at increasing the patient's ability to function with minimal or no supervision in the community. • Reduce environmental structure. • Help the patient plan for adapting ADLs for self into the home environment. • Discuss and adapt home-living skills (e.g., cleaning, cooking) to patient's ability. • Provide standby assistance, as needed, for ADLs and home-living skills.
VIII: Purposeful, appropriate	Alert, oriented, intact memory; has realistic goals for the future. Able to complete familiar tasks for 1 hour in a distracting environment; overestimates or underestimates abilities, argumentative, easily frustrated, self-centered; uncharacteristically dependent/independent	
IX: Purposeful, appropriate	Independently shifts back and forth between tasks and completes them accurately for at least 2 consecutive hours; uses assistive memory devices to recall schedule and activities; aware of and acknowledges impairments and disabilities when they interfere with task completion; depression may continue; may be easily irritable and have a low frustration tolerance	• Provide assistance on request for adapting ADLs and home-living skills.

(*Continued*)

(*Continued*)

X: Purposeful, appropriate	Able to handle multiple tasks simultaneously in all environments but may require periodic breaks; independently initiates and carries out familiar and unfamiliar tasks but may require more than usual amount of time and/or compensatory strategies to complete them; accurately estimates abilities and independently adjusts to task demands; periodic periods of depression may occur; irritability and low frustration tolerance when sick, fatigued, and/or under stress	• Monitor for signs and symptoms of depression. • Help the patient plan, anticipate concerns, and solve problems.

ADLs, activities of daily living.

Adapted from Los Amigos Research and Education Institute, Inc., Downey, CA, 2002. Used with permission.

family relationships. Families report difficulties in coping with changes in the patient's temperament, behavior, and personality (Tam et al., 2015). Such changes are associated with disruption in family cohesion, loss of leisure pursuits, and loss of work capacity, as well as social isolation of the caretaker. The family may experience marital disruption, anger, grief, guilt, and denial in recurring cycles.

To promote effective coping, the nurse can ask the family how the patient is different now, what has been lost, and what is most difficult about coping with this situation. Helpful interventions include providing family members with accurate and honest information and encouraging them to continue to set well-defined short-term goals. Family counseling helps address the family members' acute feelings of loss and helplessness and gives them guidance for the management of inappropriate behaviors. Support groups help the family members share problems, develop insight, gain information, network, and gain assistance in maintaining realistic expectations, hope, and a good quality of life (Tam et al., 2015).

Many patients with severe head injury die of their injuries, and many of those who survive experience long-term disabilities that prevent them from resuming their previous roles and functions. During the most acute phase of injury, family members need factual information and support from the health care team.

Many patients with severe head injuries that result in brain death are young and otherwise healthy and are therefore considered for organ donation. Family members of patients with such injuries need support during this extremely stressful time and assistance in making decisions to end life support and permit donation of organs. They need to know that the patient who is brain dead and whose respiratory and cardiovascular systems are maintained through life support is not going to survive and that the severe head injury, not the removal of the patient's organs or the removal of life support, is the cause of the patient's death. Bereavement counselors and members of the organ procurement team are often very helpful to family members in making decisions about organ donation and in helping them cope with stress.

Monitoring and Managing Potential Complications

Decreased Cerebral Perfusion Pressure. Maintenance of adequate CPP is important to prevent serious complications of head injury due to decreased cerebral perfusion. Adequate CPP is greater than 50 mm Hg. If CPP falls below a patient's threshold, a vasodilating cascade occurs, causing the volume of blood to increase inside the brain, which causes ICP to increase. Measures to maintain adequate CPP are essential because a decrease in CPP can impair cerebral perfusion and cause brain hypoxia and ischemia, leading to permanent brain damage. Once the threshold CPP is reached, vasoconstriction of the cerebral blood vessels occurs, causing ICP to decrease. Therapy (e.g., elevation of the head of the bed, increased IV fluids, CSF drainage) is directed toward decreasing cerebral edema and increasing venous outflow from the brain. Systemic hypotension, which causes vasoconstriction and a significant decrease in CPP, is treated with increased IV fluids or vasopressors (Griesdale, Ortenwall, Norena, et al., 2015); (Perez-Barcena et al., 2014).

Cerebral Edema and Herniation. The patient with a head injury is at risk for additional complications such as increased ICP and brainstem herniation. Cerebral edema is the most common cause of increased ICP in the patient with a head injury, with the swelling peaking approximately 48 to 72 hours after injury. Bleeding also may increase the volume of contents within the rigid, closed compartment of the skull, causing increased ICP and herniation of the brainstem and resulting in irreversible brain anoxia and brain death (Hickey, 2014); (Perez-Barcena et al., 2014). Measures to control ICP are listed in Chart 51-5 and discussed in Chapter 49.

Impaired Oxygenation and Ventilation. Impaired oxygen and ventilation may require mechanical ventilatory support. The patient must be monitored for a patent airway, altered breathing patterns, and hypoxemia and pneumonia. Interventions may include endotracheal intubation, mechanical ventilation, and positive end-expiratory pressure. See Chapters 11 and 49 for a detailed discussion of these topics.

Impaired Fluid, Electrolyte, and Nutritional Balance. Fluid, electrolyte, and nutritional imbalances are common in the patient with a head injury. Common imbalances include hyponatremia,

Chart 51-5

Controlling ICP in Patients with Severe Brain Injury

- Elevate the head of the bed as prescribed.
- Maintain the patient's head and neck in neutral alignment (no twisting or flexing the neck).
- Initiate measures to prevent the Valsalva maneuver (e.g., stool softeners).
- Maintain body temperature within normal limits.
- Administer oxygen (O_2) to maintain partial pressure of arterial oxygen (PaO_2) >90 mm Hg.
- Maintain fluid balance with normal saline solution.
- Avoid noxious stimuli (e.g., excessive suctioning, painful procedures).
- Administer sedation to reduce agitation.
- Maintain cerebral perfusion pressure of 50–70 mm Hg.

Adapted from Bader, M. K., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing. (6th ed). Chicago, IL: American Association of Neuroscience Nurses.

which is often associated with SIADH (see Chapters 7 and 32), hypokalemia, and hyperglycemia. Modifications in fluid intake with tube feedings or IV fluids, including hypertonic saline, may be necessary to treat these imbalances (Hickey, 2014). Insulin administration may be prescribed to treat hyperglycemia; blood glucose levels are maintained between 80 and 160 mg/dL (Perez-Barcena et al., 2014).

Undernutrition is also a common problem in response to the increased metabolic needs associated with severe head injury. Decisions about early feeding should be individualized; options include IV hyperalimentation or placement of a feeding tube (jejunal or gastric). Caloric expenditure can increase up to 120% to 140% with TBI, requiring close monitoring of nutritional status, with a higher concentration of protein if tolerated (Horn, Kinikini, Moore, et al., 2015).

Posttraumatic Seizures. Patients with head injury are at an increased risk for posttraumatic seizures. Posttraumatic seizures are classified as immediate (within 24 hours after injury), early (within 1 to 7 days after injury), or late (more than 7 days after injury) (Hickey, 2014). Seizure prophylaxis is the practice of administering anticonvulsant medications to patients with head injury to prevent seizures. It is important to prevent posttraumatic seizures, especially in the immediate and early phases of recovery, because seizures may increase ICP and decrease oxygenation (Zaman, Dubiel, Driver, et al., 2017). However, many anticonvulsant medications impair cognitive performance and can prolong the duration of rehabilitation. Therefore, the overall benefits of these medications must be weighed against their side effects. Research evidence supports the use of prophylactic anticonvulsant agents to prevent immediate and early seizures after head injury, but not for prevention of late seizures (Hickey, 2014); (Zaman et al., 2017). See Chapter 49 for the nursing management of seizures.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. Education early in the course of head injury often focuses on reinforcing information given to the family about the patient's condition and prognosis. As the patient's status and expected outcome change over time, family education may focus on interpretation and explanation of changes in the patient's physical and psychological responses.

Once the patient's physical status allows discharge to home, a rehabilitation center, or a subacute care facility, the patient and family are educated about limitations that can be expected and complications that may occur. The nurse explains to the patient and family, verbally and in writing, how to monitor for complications that merit contacting the primary provider. Depending on the patient's prognosis and physical and cognitive status, the patient may be included in education about self-care management strategies.

If the patient is at risk for late posttraumatic seizures, anticonvulsant medications may be prescribed at discharge. The patient and family require education about the side effects of these medications and the importance of continuing to take them as prescribed.

Continuing and Transitional Care. The rehabilitation phase of care for the patient with a TBI begins at hospital admission. Admission to the rehabilitation unit is a milestone in a patient's recovery and requires intense work by the patient to complete the daily schedule of therapies. The goals of rehabilitation are to maximize the patient's ability to return to their highest level of functioning and to their home and the community, address concerns before discharge for a smooth transition to home or rehabilitation, and promote independence with adaptation to deficits. The patient is encouraged to continue the rehabilitation program after discharge, because improvement in status may continue 3 or more years after injury. Changes in the patient with a TBI and the effects of long-term rehabilitation on the family and their coping abilities need ongoing assessment. Continued education and support of the patient and family are essential as their needs and the patient's status change. Education to address with the family of the patient who is about to return home is described in Chart 51-6.

Depending on status, the patient is encouraged to return to usual activities gradually. During the acute and rehabilitation phases of care, the focus of education is on obvious needs, issues, deficits, and complications. Complications after TBI include infections (e.g., pneumonia, urinary tract infection [UTI], sepsis, wound infection, osteomyelitis, meningitis,

Chart 51-6 HOME CARE CHECKLIST

The Patient with a TBI

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of TBI and treatment on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State the purpose, dose, route, schedule, side effects, and precautions for prescribed medications.
- State how to contact all members of the treatment team (e.g., health care providers, home care professionals, rehabilitation team, and durable medical equipment and supply vendor).
- State changes in lifestyle (e.g., ADLs, IADLs, activity) necessary for recovery and health maintenance, as applicable.
  - Demonstrate safe techniques to assist patient with self-care, hygiene, and ambulation.
  - Demonstrate safe techniques for eating, feeding patient, or assisting patient with eating.
  - Identify need for close monitoring of behavior due to changes in cognitive functioning.
  - Describe strategies for reinforcing positive behaviors.
  - Describe household modifications needed to ensure safe environment for the patient.
- Explain the need for monitoring for changes in neurologic status and for complications.
- Identify changes in neurologic status and signs and symptoms of complications (e.g., pneumonia, urinary tract infection, meningitis) that should be reported to the neurosurgeon or nurse.
- Relate how to reach primary provider with questions or complications.
- State importance of continuing follow-up by health care team.
- State time and date of follow-up medical appointments, therapy, and testing.
- Identify sources of support (e.g., friends, relatives, faith community, brain injury support groups, caregiver support).
- Identify the need for health-promotion, disease prevention, and screening activities.

ADL, activities of daily living; IADL, independent activities of daily living; TBI, traumatic brain injury.

ventriculitis, brain abscess) and heterotopic ossification (painful bone overgrowth in weight-bearing joints).

The nurse needs to remind the patient and family of the need for continuing health promotion and screening practices after the initial phase of care. Patients who have not been involved in these practices in the past are educated about their importance and are referred to appropriate health care providers.

Evaluation

Expected patient outcomes may include:

1. Attains or maintains effective airway clearance, ventilation, and brain oxygenation
   a. Achieves blood gas values within normal limits and has breath sounds clear on auscultation
   b. Mobilizes and clears secretions
2. Achieves satisfactory fluid and electrolyte balance
   a. Demonstrates serum electrolytes within normal limits
   b. Has no clinical signs of dehydration or overhydration
3. Attains adequate nutritional status
   a. Is free of gastric distention and vomiting
   b. Shows minimal weight loss
4. Avoids injury
   a. Shows lessening agitation and restlessness
   b. Is oriented to person, place, and time
5. Maintains body temperature within normal limits
   a. Absence of fever
   b. Absence of hypothermia
6. Demonstrates intact skin integrity
   a. Exhibits no redness or breaks in skin integrity
   b. Exhibits no pressure ulcers
7. Shows improvement in coping
8. Demonstrates usual sleep–wake cycle
9. Family demonstrates adaptive family processes
   a. Joins support group
   b. Shares feelings with appropriate health care personnel
   c. Makes end-of-life decisions, if needed
10. Demonstrates absence of complications
    a. Demonstrates ICP within normal limits
    b. Exhibits vital signs and body temperature within normal limits and increases orientation to person, place, and time
11. Experiences no posttraumatic seizures
    a. Takes anticonvulsant medications as prescribed
    b. Identifies side effects/adverse effects of anticonvulsant medications
12. Participates in rehabilitation process as indicated for patient and family members
    a. Takes active role in identifying rehabilitation goals and participating in recommended patient care activities
    b. Prepares for discharge

Spinal Cord Injury

Spinal cord injury (SCI), an injury to the spinal cord, vertebral column, supporting soft tissue, or intervertebral discs caused by trauma is a major health disorder. Incidence rates of spinal cord injury range from 12.06 to 61.6 per million, and the average age of SCI is 26.8 to 56.6 years old in Asian countries (Ning, Wu, Li, & Feng, 2012), whereas in India, the age group of 20–49 years is most affected by SCI (Mathur et al., 2015). Furthermore, men are at higher risk than women (Ning et al., 2012; Singh, Sharma, Mittal, & Sharma, 2003). Major causes of SCI are motor vehicle accidents (59.5%) and fall injury (37.8%). In India, the major cause of SCI is fall injury followed by motor vehicle accidents (Chacko, Joseph, Mohanty, & Jacob, 1986; Mathur et al., 2015; Singh et al., 2003). Though tremendous advances have improved the life expectancy of patients with SCI, it still remains lower than that of the general population, particularly during the first year postinjury, as well as for patients who sustain severe SCI (NSCISC, 2016).

The predominant risk factors for SCI include younger age, male gender, and alcohol and drug use (Bader et al., 2016). The frequency with which these risk factors are associated with SCI serves to emphasize the importance of primary prevention. The same interventions suggested earlier in this chapter for head injury prevention help decrease the incidence of SCI (see Chart 51-1). Life expectancy continues to increase for people with SCI because of improved health care but remains slightly lower than for those without SCI. The major causes of death are pneumonia, pulmonary embolism (PE), and sepsis (Hickey, 2014).

Paraplegia (paralysis of the lower body) and tetraplegia (paralysis of all four extremities; formerly called *quadriplegia*) can occur, with incomplete tetraplegia being the most frequently occurring injury, followed by complete paraplegia, complete tetraplegia, and incomplete paraplegia.

Pathophysiology

Damage in SCI ranges from transient concussion (from which the patient fully recovers) to contusion, laceration, and compression of the spinal cord tissue (either alone or in combination), to complete transection (severing) of the spinal cord (which renders the patient paralyzed below the level of the injury). The vertebrae most frequently involved are the 5th, 6th, and 7th cervical vertebrae (C5–C7), the 12th thoracic vertebra (T12), and the 1st lumbar vertebra (L1). These vertebrae are most susceptible because there is a greater range of mobility in the vertebral column in these areas (Hickey, 2014).

SCIs can be separated into two categories: primary injuries and secondary injuries. Primary injuries are the result of the initial insult or trauma and are usually permanent. Secondary injuries resulting from SCI include edema and hemorrhage (Bader et al., 2016); (Mohit, 2016). The secondary injury is a major concern for critical care nurses. Early treatment is essential to prevent partial damage from becoming total and permanent.

Clinical Manifestations

Manifestations of SCI depend on the type and level of injury (see Chart 51-7). The type of injury refers to the extent of injury to the spinal cord itself. A complete spinal cord lesion signifies loss of both sensory and voluntary motor communication from the brain to the periphery, resulting in paraplegia or tetraplegia (Bader et al., 2016). Incomplete spinal cord lesion denotes that the ability of the spinal cord to relay messages to and from the brain is not completely absent. Sensory and/or motor fibers are preserved below the lesion. Injuries are classified according to the area of spinal cord damage: central, lateral, anterior, or peripheral (see Chart 51-7).

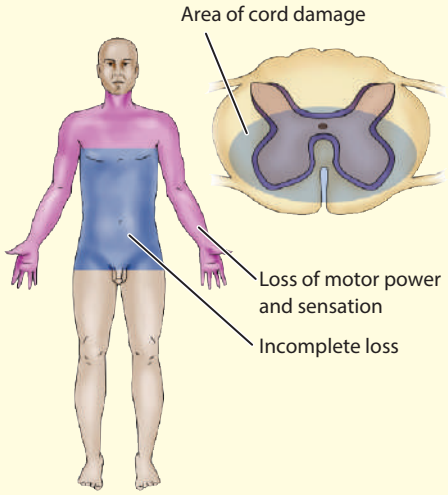
The American Spinal Injury Association (ASIA) provides classification of SCI according to the degree of sensory and motor function present after injury (see Fig. 51-5; (ASIA, 2016)).

Chart 51-7

Effects of Spinal Cord Injuries

Central Cord Syndrome

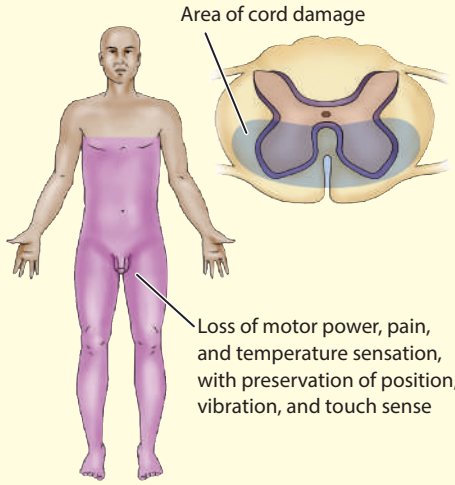
- *Characteristics*: Motor deficits (in the upper extremities compared to the lower extremities; sensory loss varies but is more pronounced in the upper extremities); bowel/bladder dysfunction is variable, or function may be completely preserved.
- *Cause*: Injury or edema of the central cord, usually of the cervical area. May be caused by hyperextension injuries.



Central cord syndrome

Anterior Cord Syndrome

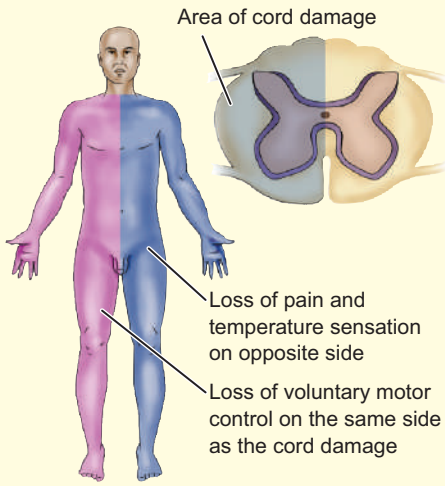
- *Characteristics*: Loss of pain and temperature sensation and motor function is noted below the level of the lesion; light touch, position, and vibration sensation remain intact.
- *Cause:* The syndrome may be caused by acute disc herniation or hyperflexion injuries associated with fracture/dislocation of vertebra. It also may occur as a result of injury to the anterior spinal artery, which supplies the anterior two thirds of the spinal cord.



Anterior cord syndrome

Lateral Cord Syndrome (Brown–Séquard Syndrome)

- *Characteristics*: Ipsilateral paralysis or paresis is noted, together with ipsilateral loss of touch, pressure, and vibration and contralateral loss of pain and temperature sensation.
- *Cause:* The lesion is caused by a transverse hemisection of the cord (half of the cord is transected from north to south), usually as a result of a knife or missile injury, fracture/dislocation of a unilateral articular process, or possibly an acute ruptured disc.



Brown–Séquard syndrome

Adapted from Hickey, J. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

The neurologic level refers to the lowest level at which sensory and motor functions are intact. Below the neurologic level, there may be total or partial, sensory and/or motor paralysis (dependent upon affected tracts), loss of bladder and bowel control (usually with urinary retention and bladder distention), loss of sweating and vasomotor tone, and marked reduction of blood pressure from loss of peripheral vascular resistance.

If conscious, the patient usually complains of acute pain in the back or neck, which may radiate along the involved nerve. However, absence of pain does not rule out spinal injury, and a careful assessment of the spine should be conducted if there has been a significant force and mechanism of injury (i.e., concomitant head injury).

Respiratory dysfunction is related to the level of injury. The muscles contributing to respiration are the diaphragm (C4), intercostals (T1–T6), and abdominals (T6–T12). Injuries at C4 or above (causing paralysis of the diaphragm) often will require ventilator support, since acute respiratory failure is a leading

cause of death (Hickey, 2014). Injuries of T12 and above will have impact on respiratory function. Functional abilities by level of injury are described in Table 51-3.

Assessment and Diagnostic Findings

A detailed neurologic examination is performed. Diagnostic x-rays (lateral cervical spine x-rays) and CT scanning are usually performed initially. An MRI scan may be ordered as a further workup if a ligamentous injury is suspected, because significant spinal cord damage may exist even in the absence of bony injury (Hickey, 2014). If an MRI scan is contraindicated, a myelogram may be used to visualize the spinal axis. An assessment is made for other injuries, because spinal trauma often is accompanied by concomitant injuries, commonly to the head and chest. Continuous electrocardiographic monitoring may be indicated if an SCI is suspected, because bradycardia (slow heart rate) and asystole (cardiac standstill) are common in patients with acute spinal cord injuries.

Emergency Management

The immediate management at the scene of the injury is critical, because improper handling of the patient can cause further damage and loss of neurologic function. Any patient who is involved in a motor vehicle crash, a diving or contact sports injury, a fall, or any direct trauma to the head and neck must be considered to have SCI until such an injury is ruled out. Initial care must include a rapid assessment, immobilization, extrication, and stabilization or control of life-threatening injuries, and transportation to the most appropriate medical facility. Immediate transportation to a trauma center with the capacity to manage major neurologic trauma is then necessary (Hickey, 2014).

At the scene of the injury, the patient must be immobilized on a spinal (back) board, with the head and neck maintained in a neutral position, to prevent an incomplete injury from becoming complete. One member of the team must assume control of the patient's head to prevent flexion, rotation, or extension; this is done by placing the hands on both sides of the patient's head at about ear level to limit movement and maintain alignment while a spinal board and/or cervical immobilizing device is applied. If possible, at least four people should slide the patient carefully onto a board for transfer to the hospital. Head blocks should also be considered, as they will further limit any neck movement. Any twisting movement may irreversibly damage the spinal cord by causing bony fragment

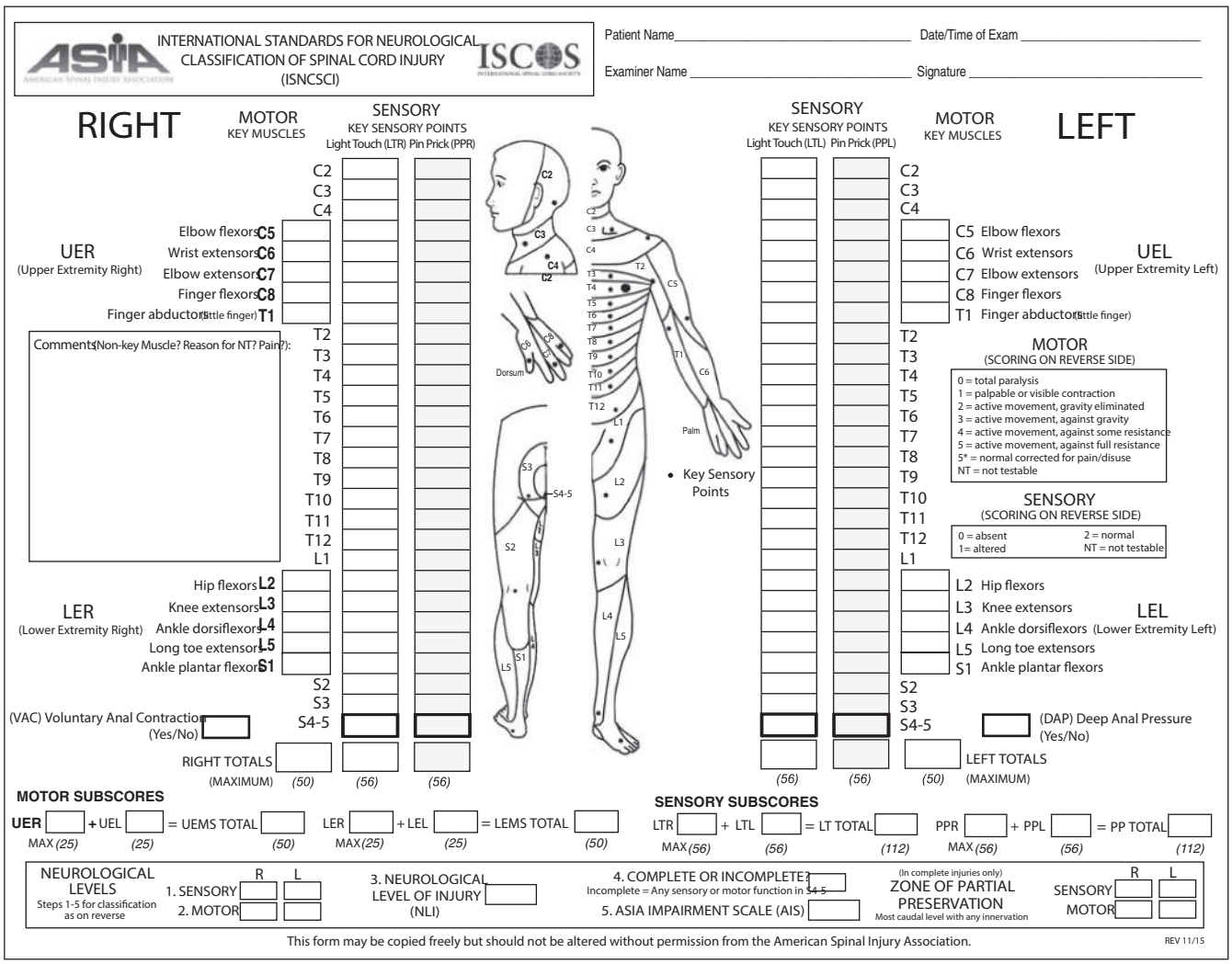


Figure 51-5 • Worksheet for the classification of SCI. Adapted from American Spinal Injury Association (ASIA). (2016). International standards for neurological classification of spinal cord injury. Retrieved on 2/23/17 at: www.asia-spinalinjury.org/wp-content/uploads/2016/02/International_Stds_Diagram_Worksheet.pdf. (*Continued*)

Muscle Function Grading

0 = total paralysis
1 = palpable or visible contraction
2 = active movement, full range of motion (ROM) with gravity eliminated
3 = active movement, full ROM against gravity
4 = active movement, full ROM against gravity and moderate resistance in a muscle specific position
5 = (normal) active movement, full ROM against gravity and full resistance in a functional muscle position expected from an otherwise unimpaired person
5* = (normal) active movement, full ROM against gravity and sufficient resistance to be considered normal if identified inhibiting factors (i.e. pain, disuse) were not present
NT = not testable (i.e. due to immobilization, severe pain such that the patient cannot be graded, amputation of limb, or contracture of > 50% of the normal ROM)

Sensory Grading

0 = Absent
1 = Altered, either decreased/impaired sensation or hypersensitivity
2 = Normal
NT = Not testable

When to Test Non-Key Muscles:

In a patient with an apparent AIS B classification, non-key muscle functions more than 3 levels below the motor level on each side should be tested to most accurately classify the injury (differentiate between AIS B and C).

Movement	Root level
Shoulder: Flexion, extension, abduction, adduction, internal and external rotation **Elbow:** Supination	C5
Elbow: Pronation **Wrist:** Flexion	C6
Finger: Flexion at proximal joint, extension. **Thumb:** Flexion, extension and abduction in plane of thumb	C7
Finger: Flexion at MCP joint **Thumb:** Opposition, adduction and abduction perpendicular to palm	C8
Finger: Abduction of the index finger	T1
Hip: Adduction	L2
Hip: External rotation	L3
Hip: Extension, abduction, internal rotation **Knee:** Flexion **Ankle:** Inversion and eversion **Toe:** MP and IP extension	L4
Hallux and Toe: DIP and PIP flexion and abduction	L5
Hallux: Adduction	S1

ASIA Impairment Scale (AIS)

A = Complete. No sensory or motor function is preserved in the sacral segments S4-5.

B = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep anal pressure) AND no motor function is preserved more than three levels below the motor level on either side of the body.

C = Motor Incomplete. Motor function is preserved at the most caudal sacral segments for voluntary anal contraction (VAC) OR the patient meets the criteria for sensory incomplete status (sensory function preserved at the most caudal sacral segments (S4-S5) by LT, PP or DAP), and has some sparing of motor function more than three levels below the ipsilateral motor level on either side of the body.
(This includes key or non-key muscle functions to determine motor incomplete status.) For AIS C – less than half of key muscle functions below the single NLI have a muscle grade ≥ 3.

D = Motor Incomplete. Motor incomplete status as defined above, with at least half (half or more) of key muscle functions below the single NLI having a muscle grade ≥ 3.

E = Normal. If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

Using ND: To document the sensory, motor and NLI levels, the ASIA Impairment Scale grade, and/or the zone of partial preservation (ZPP) when they are unable to be determined based on the examination results.

ASIA
AMERICAN SPINAL INJURY ASSOCIATION
INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY
ISCOS

Steps in Classification

The following order is recommended for determining the classification of individuals with SCI.

1. Determine sensory levels for right and left sides.
The sensory level is the most caudal, intact dermatome for both pin prick and light touch sensation.

2. Determine motor levels for right and left sides.
Defined by the lowest key muscle function that has a grade of at least 3 (on supine testing), providing the key muscle functions represented by segments above that level are judged to be intact (graded as a 5).
Note: in regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level, if testable motor function above that level is also normal.

3. Determine the neurological level of injury (NLI)
This refers to the most caudal segment of the cord with intact sensation and antigravity (3 or more) muscle function strength, provided that there is normal (intact) sensory and motor function rostrally respectively.
The NLI is the most cephalad of the sensory and motor levels determined in steps 1 and 2.

4. Determine whether the injury is Complete or Incomplete.
(i.e. absence or presence of sacral sparing)
*If voluntary anal contraction = **No** AND all S4-5 sensory scores = **0***
*AND deep anal pressure = **No,** then injury is **Complete.***
*Otherwise, injury is **Incomplete.***

5. Determine ASIA Impairment Scale (AIS) Grade:
Is injury Complete? **If YES, AIS=A** and can record ZPP (lowest dermatome or myotome on each side with some preservation)
NO ↓
Is injury Motor Complete? **If YES, AIS=B**
NO ↓ (No=voluntary anal contraction OR motor function more than three levels below the motor level on a given side, if the patient has sensory incomplete classification)

Are at least half (half or more) of the key muscles below the neurological level of injury graded 3 or better?
NO ↓ **AIS=C** **YES** ↓ **AIS=D**

If sensation and motor function is normal in all segments, AIS=E
Note: AIS E is used in follow-up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.

Figure 51-5 • (*Continued*) Worksheet for the classification of SCI. Adapted from American Spinal Injury Association (ASIA). (2016). International standards for neurological classification of spinal cord injury. Retrieved on 2/23/17 at: www.asia-spinalinjury.org/wp-content/uploads/2016/02/International_Stds_Diagram_Worksheet.pdf.

or disc movement or exacerbating ligamentous injury, causing further instability (Bader et al., 2016).

The patient is referred to a tertiary care providing spinal injury or trauma center because of the multidisciplinary personnel and support services required to counteract the destructive changes that occur in the first 24 hours after injury. During treatment in the emergency and x-ray departments, the patient is kept on the transfer board. The patient must always be maintained in an extended position. No part of the body should be twisted or turned, and the patient is not allowed to sit up. Once the extent of the injury has been determined, the patient may be placed on a rotating specialty bed or in a cervical collar (see Fig. 51-6). Later, if SCI and bone instability have been ruled out, the patient may be moved to a conventional bed or the collar may be removed without harm. If a specialty bed is needed but not available, the patient should be placed in a cervical collar and on a firm mattress.



Figure 51-6 • Cervical collar. Used with permission from Aspen Medical Products.

Medical Management (Acute Phase)

The goals of management are to prevent secondary injury, to observe for symptoms of progressive neurologic deficits, and to prevent complications. The patient is resuscitated as necessary, and oxygenation and cardiovascular stability are maintained.

TABLE 51-3 Functional Abilities by Level of Cord Injury

Injury Level	Segmental Sensorimotor Function	Dressing, Eating	Elimination	Mobility[a]
C1	Little or no sensation or control of head and neck; no diaphragm control; requires continuous ventilation	Dependent	Dependent	Limited. Voice or sip-n-puff controlled electric wheelchair
C2–C3	Head and neck sensation; some neck control; independent of mechanical ventilation for short periods	Dependent	Dependent	Same as for C1
C4	Good head and neck sensation and motor control; some shoulder elevation; diaphragm movement	Dependent; may be able to eat with adaptive sling	Dependent	Limited to voice, mouth, head, chin, or shoulder-controlled electric wheelchair
C5	Full head and neck control; shoulder strength; elbow flexion	Independent with assistance	Maximal assistance	Electric or modified manual wheelchair, needs transfer assistance
C6	Fully innervated shoulder; wrist extension or dorsiflexion	Independent or with minimal assistance	Independent or with minimal assistance	Independent in transfers and wheelchair
C7–C8	Full elbow extension; wrist plantar flexion; some finger control	Independent	Independent	Independent; manual wheelchair
T1–T5	Full hand and finger control; use of intercostal and thoracic muscles	Independent	Independent	Independent; manual wheelchair
T6–T10	Abdominal muscle control, partial to good balance with trunk muscles	Independent	Independent	Independent; manual wheelchair
T11–L5	Hip flexors, hip abductors (L1–L3); knee extension (L2–L4); knee flexion and ankle dorsiflexion (L4–L5)	Independent	Independent	Short distance to full ambulation with assistance
S1–S5	Full leg, foot, and ankle control; innervation of perineal muscles for bowel, bladder, and sexual function (S2–S4)	Independent	Normal to impaired bowel and bladder function	Ambulate independently with or without assistance

[a]Assistance refers to adaptive equipment, setup, or physical assistance.

Adapted from Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

SCI is a devastating event; new treatment methods and medications are continually being investigated for the acute and chronic phases of care (Perez-Barcena et al., 2014); (Stocchetti & Maas, 2014).

Pharmacologic Therapy

Administration of high-dose IV corticosteroids (methylprednisolone sodium succinate [Solu-Medrol]) in the first 24 or 48 hours is controversial. The validity of studies has been questioned based on critical analysis of the original and additional data. As a result, there is now a consensus that corticosteroids may offer only a slight benefit. Corticosteroids are no longer considered the standard of care for acute SCI, although some centers continue to use corticosteroid protocols (Hickey, 2014).

Respiratory Therapy

Oxygen is given to maintain a high partial pressure of arterial oxygen (PaO_2), because hypoxemia can create or worsen a neurologic deficit of the spinal cord. If endotracheal intubation is necessary, extreme care is taken to avoid flexing or extending the patient's neck, which can result in extension of a cervical injury.

In high cervical spine injuries, spinal cord innervation to the phrenic nerve, which stimulates the diaphragm, is lost. Diaphragmatic pacing (electrical stimulation of the phrenic nerve) attempts to stimulate the diaphragm to help the patient breath. Intramuscular diaphragmatic pacing is currently in the clinical trial phase for the patient with a high cervical injury. This is implanted via laparoscopic surgery, usually after the acute phase.

Skeletal Fracture Reduction and Traction

Management of SCI requires immobilization and reduction of dislocations (restoration of preinjury position) and stabilization of the vertebral column. This can be accomplished by surgical and/or nonsurgical interventions; both aim to prevent new or worsening neurologic damage.

Cervical fractures can be reduced, and the cervical spine aligned with some form of skeletal traction, such as with skeletal tongs or with the use of the halo device (Bader et al., 2016). Traction is applied to the skeletal traction device by weights (ensuring the weights are unencumbered); the amount depends on the size of the patient and the degree of fracture displacement (see Fig. 51-7). The traction force is exerted along the longitudinal axis of the vertebral bodies, with the patient's neck in a neutral position. The traction is then gradually increased by adding more weights. As the amount of traction is increased, the spaces between the intervertebral discs widen and the vertebrae are given a chance to slip back into position. Reduction usually occurs after correct alignment has been restored. Once reduction is achieved, as verified by cervical spine x-rays and neurologic examination, the weights are gradually removed until the amount of weight needed to maintain the alignment is identified. Traction is sometimes supplemented with manual manipulation of the neck by a surgeon, to help achieve realignment of the vertebral bodies.

A halo device may be used initially with traction or may be applied after removal of the tongs. It consists of a titanium or stainless steel halo ring that is fixed to the skull by four pins,

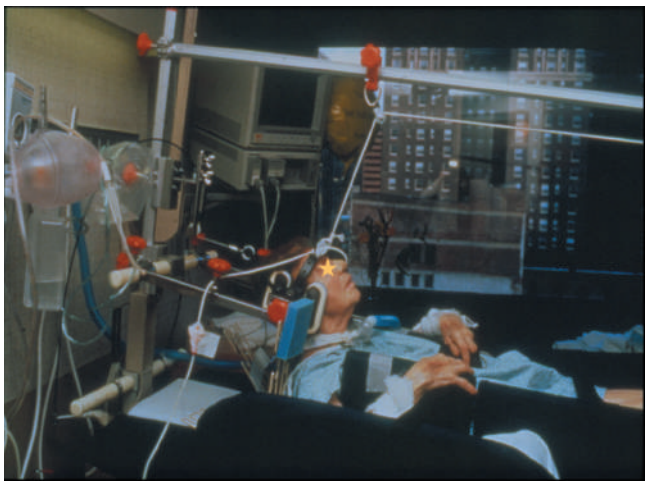


Figure 51-7 • Patient in skeletal traction in a rotating specialty bed. Adapted from Schwartz, E. D., Adam, E., & Flander, S. (2007). Spinal trauma: Imaging, diagnosis, and management. Philadelphia, PA: Lippincott Williams & Wilkins.

which are inserted into the outer table of the skull. The ring is attached to a removable halo vest, a device that suspends the weight of the unit circumferentially around the chest. A frame connects the ring to the chest. Halo devices provide immobilization of the cervical spine while allowing early ambulation (see Fig. 51-8) for patients with adequate function.



Figure 51-8 • Halo and vest for cervical and thoracic injuries. Adapted from Schwartz, E. D., Adam, E., & Flander, S. (2007). Spinal trauma: Imaging, diagnosis, and management. Philadelphia, PA: Lippincott Williams & Wilkins.

Thoracic and lumbar injuries are usually treated with surgical intervention, followed by immobilization with a fitted brace. Traction is often not indicated either before or after surgery, due to the relative stability of the spine in these regions.

Nursing Alert: The patient's vital organ functions and body defenses must be supported and maintained until spinal and neurogenic shock abates and the neurologic system have recovered from the traumatic insult; this can take up to 4 months.

Surgical Management

Surgery is indicated in any of the following situations:

- Compression of the cord is evident.
- The injury results in a fragmented or unstable vertebral body.
- The injury involves a wound that penetrates the cord.
- Bony fragments are in the spinal canal.
- The patient's neurologic status is deteriorating.

Early surgical stabilization may improve the clinical outcome of patients compared to surgery performed later during the clinical course. The goals of surgical treatment are to preserve neurologic function by removing pressure from the spinal cord and to provide stability.

Management of Acute Complications of Spinal Cord Injury

Spinal and Neurogenic Shock

The spinal shock associated with SCI reflects a sudden depression of reflex activity in the spinal cord (areflexia) below the level of injury. The muscles innervated by the part of the spinal cord segment below the level of the lesion are without sensation, paralyzed, and flaccid, and the reflexes are absent. Blood pressure may be decreased and the patient may be bradycardic. Studies suggest that hypotension and shock can further damage the spinal cord and that the mean arterial pressure (MAP) should be maintained at 85 mm Hg or higher during the hyperacute phase (Jia, Kowalski, Sciubba, et al., 2013). The reflexes that initiate bladder and bowel function are affected. Bowel distention and paralytic ileus can be caused by depression of the reflexes and are treated with intestinal decompression by insertion of a nasogastric tube. A paralytic ileus most often occurs within the first 2 to 3 days after SCI and resolves within 3 to 7 days (Bader et al., 2016).

Neurogenic shock develops as a result of the loss of autonomic nervous system function below the level of the lesion. The vital organs are affected, causing decreases in blood pressure, heart rate, and cardiac output, as well as venous pooling in the extremities and peripheral vasodilation (Bader et al., 2016). In addition, the patient does not perspire in the paralyzed portions of the body, because sympathetic activity is blocked; therefore, close observation is required for early detection of an abrupt onset of fever. See Chapter 8 for further discussion of neurogenic shock.

With injuries to the cervical and upper thoracic spinal cord, innervation to the major accessory muscles of respiration is lost and respiratory problems develop. These include decreased vital capacity, retention of secretions, increased partial pressure of arterial carbon dioxide ($PaCO_2$) levels and decreased oxygen levels, respiratory failure, and pulmonary edema.

Venous Thromboembolism

The risk of venous thromboembolism (VTE) is a potential complication of immobility and occurs in patients with SCI

at the same rate as those having had other types of traumatic injuries (Bader et al., 2016). Patients who develop VTE are at high risk for both deep vein thrombosis (DVT) and PE due to immobility, flaccidity, and decreased vasomotor tone (Jia et al., 2013).

Manifestations of PE include pleuritic chest pain, anxiety, shortness of breath, and abnormal blood gas values (increased $PaCO_2$ and decreased PaO_2). A fatal PE has been reported in up to 2% of patients with SCI within the first 3 months postinjury (Hickey, 2014).

Low-dose anticoagulation therapy usually is initiated to prevent DVT and PE, along with the use of antiembolism stockings or sequential pneumatic compression devices (SCDs). In some cases, permanent indwelling filters (see Chapter 12) may be placed prophylactically in the vena cava to prevent emboli (dislodged clots) from migrating to the lungs and causing PE. Prevention continues into the rehabilitation and chronic phases of SCI care (Abrams & Wakasa, 2014); (Jia et al., 2013).

Nursing Alert: The calves or thighs of a patient who is immobile should never be massaged because of the danger of dislodging an undetected thromboembolus.

Other Complications

In addition to respiratory complications (respiratory failure, pneumonia) and autonomic dysreflexia, other complications that may occur include pressure ulcers and infection (urinary, respiratory, and local infection at the skeletal traction pin sites).

NURSING PROCESS

The Patient with Acute Spinal Cord Injury

Assessment

The patient's breathing pattern and the strength of the cough are assessed and the lungs are auscultated, because paralysis of the diaphragm, in addition to abdominal and respiratory muscles, diminishes coughing and makes clearing of bronchial and pharyngeal secretions difficult. Reduced excursion of the chest also results.

The patient is monitored closely for any changes in motor or sensory function and for symptoms of progressive neurologic damage. In the early stages of SCI, determining whether the cord has been severed may not be possible, because signs and symptoms of cord edema are indistinguishable from those of cord transection. Edema of the spinal cord may occur with any severe cord injury and may further compromise spinal cord function.

Motor and sensory functions are assessed through careful neurologic examination. These findings are recorded on a flow sheet so that changes in the baseline neurologic status can be monitored closely and accurately. The ASIA classification is commonly used to describe the level of function for patients with SCI (see Fig. 51-5). Chart 51-7 also gives examples of the effects of altered spinal cord function. At the minimum:

- Motor ability is tested by asking the patient to spread the fingers, squeeze the examiner's hand, and move the toes or turn the feet.
- Sensation is evaluated by gently pinching the skin or touching it lightly with an object such as a tongue blade, starting at shoulder level and working down both sides of the extremities. The patient should have both eyes closed so that the examination reveals true findings, not what the patient hopes to feel. The patient is asked where the sensation is felt.
- Any decrease in neurologic function is reported immediately.

The patient is also assessed for spinal shock, which is a complete loss of all reflex, motor, sensory, and autonomic activity below the level of the lesion that causes bladder paralysis and distention. The lower abdomen is palpated for signs of urinary retention and overdistention of the bladder. Further assessment is made for gastric dilation and paralytic ileus caused by an atonic bowel, a result of autonomic disruption.

Temperature is monitored because the patient may have periods of hyperthermia as a result of altered temperature control, which is due to the inability to perspire related to autonomic disruption. Body temperature becomes dependent on surroundings (poikilothermia).

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Ineffective breathing patterns related to weakness or paralysis of diaphragm, abdominal, and intercostal muscles
- Ineffective airway clearance related to muscle weakness and inability to clear secretions
- Impaired bed and physical mobility related to motor and sensory impairments
- Risk for injury related to motor and sensory impairment
- Risk for impaired skin integrity related to immobility and sensory loss
- Impaired urinary elimination related to inability to void spontaneously
- Constipation related to presence of atonic bowel as a result of autonomic disruption
- Acute pain related to treatment and prolonged immobility
- Autonomic dysreflexia related to uninhibited sympathetic response of the nervous system following SCI

Collaborative Problems/Potential Complications

Potential complications may include the following:

- VTE
- Orthostatic hypotension

Planning and Goals

The goals for the patient may include improved breathing pattern and airway clearance, improved mobility, prevention of injury due to sensory impairment, maintenance of skin integrity, relief of urinary retention, improved bowel function, decreasing pain, early recognition of autonomic dysreflexia, and absence of complications.

Nursing Interventions

Promoting Adequate Breathing and Airway Clearance

Possible impending respiratory failure is detected by observing the patient, measuring vital capacity, monitoring oxygen saturation through pulse oximetry, and monitoring arterial blood gases. Early and vigorous attention to clearing bronchial and pharyngeal secretions can prevent retention of secretions and atelectasis. Suctioning may be indicated, but it should be used with caution to avoid stimulating the vagus nerve and producing bradycardia and cardiac arrest.

If the patient cannot cough effectively because of decreased inspiratory volume and inability to generate sufficient expiratory pressure, chest physiotherapy and assisted coughing may be indicated. Specific breathing exercises are supervised by the nurse to increase the strength and endurance of the inspiratory muscles, particularly the diaphragm. Assisted coughing promotes clearing of secretions from the upper respiratory tract and is similar to the use of abdominal thrusts to clear an airway. Assisted coughing can be more effective than traditional suctioning because traditional suctioning clears the right mainstem bronchus, whereas sites for atelectasis and pneumonia are most commonly in the left lower lung lobe (Jia et al., 2013). Proper humidification and hydration are important to prevent secretions from becoming thick and difficult to remove even with coughing. The patient is assessed for signs of respiratory infection (e.g., cough, fever, dyspnea). Ascending edema of the spinal cord in the acute phase may cause respiratory difficulty that requires immediate intervention. Therefore, the patient's respiratory status must be monitored closely.

Improving Mobility

Proper body alignment is maintained at all times. If not on a specialized rotating bed, the patient should not be turned until the primary provider has indicated that it is safe to do so. Once safe for movement, the patient is repositioned frequently and is assisted out of bed as soon as the spinal column is stabilized. The feet are prone to footdrop; therefore, various types of splints are used to prevent footdrop. When used, the splints are removed and reapplied every 2 hours. Trochanter rolls, applied from the crest of the ilium to the midthigh of both legs, help prevent external rotation of the hip joints. Patients with lesions above the midthoracic level have loss of sympathetic control of peripheral vasoconstrictor activity, leading to hypotension. These patients may tolerate changes in position poorly and require monitoring of blood pressure when positions are changed.

Contractures can develop rapidly with immobility and muscle paralysis. A joint that is immobilized too long becomes fixed as a result of contractures of the tendon and joint capsule. Atrophy of the extremities results from disuse. Contractures and other complications may be prevented by range-of-motion exercises that help preserve joint motion and stimulate circulation. Passive range-of-motion exercises should be implemented as soon as possible after injury. Toes, metatarsals, ankles, knees, and hips should be put through a full range of motion at least four, or ideally five, times daily.

For most patients who have a cervical fracture without neurologic deficit, reduction in traction followed by rigid immobilization for 6 to 8 weeks restores skeletal integrity. These patients are allowed to move gradually to an erect position. A neck brace or molded collar is applied when the patient is mobilized after traction is removed (see Fig. 51-6).

Preventing Injury Due to Sensory and Perceptual Alterations

The nurse assists the patient to compensate for sensory and perceptual alterations that occur with SCI. The intact senses above the level of the injury are stimulated through touch, aromas, flavorful food and beverages, conversation, and music. Additional strategies include the following:

- Providing glasses to enable the patient to see from the supine position
- Encouraging the use of hearing aids, if indicated, to enable the patient to hear conversations and environmental sounds
- Providing emotional support to the patient and family
- Educating the patient and family about strategies to compensate for, or cope with, sensory deficits

Maintaining Skin Integrity

Pressure ulcers are a significant complication of SCI. The most common sites are over the sacrum (39.0%), heels (13.0%), ischial tuberosity (8.0%), and the occiput (back of head) (6.1%) (Jia et al., 2013). Pressure ulcers may begin within hours of an acute SCI where pressure is continuous and where the peripheral circulation is inadequate as a result of spinal shock and a recumbent position. It is important to move the patient from the backboard as soon as possible and inspect the skin. In addition, patients who wear cervical collars for prolonged periods may develop breakdown from the pressure of the collar under the chin, on the shoulders, and at the occiput. Pressure ulcers can add substantially to the personal and economic costs of living with SCI. The prevalence of this complication ranges from 17% for people 2 months after injury to 33% for those living with SCI.

The most effective approach to addressing this costly complication of SCI is prevention. The patient's position is changed at least every 2 hours (Bader et al., 2016). Turning not only assists in the prevention of pressure ulcers but also prevents pooling of blood and edema in the dependent areas. Careful inspection of the skin is made each time the patient is turned. The skin over the pressure points is assessed for redness or breaks; the perineum is checked for soilage, and the catheter is observed for adequate drainage. The patient's general body alignment and comfort are assessed. Special attention should be given to pressure areas in contact with the transfer board.

In addition, the patient's skin should be kept clean by washing with a mild soap, rinsing well, and blotting dry. Pressure-sensitive areas should be kept well lubricated and soft with oil or emollient lotion. The patient is educated about the danger of pressure ulcers and is encouraged to take control and make decisions about appropriate skin care. Other aspects of the prevention of pressure ulcers are discussed later in the chapter.

Maintaining Urinary Elimination

Immediately after SCI, the urinary bladder becomes atonic and cannot contract by reflex activity. Urinary retention is the immediate result. During the initial acute phase, a Foley catheter is inserted; however, prompt discontinuation is advised due to high risk of catheter-associated UTI. Once discontinued, the patient has no sensation of bladder distention and overstretching of the bladder and detrusor muscle may occur, delaying the return of bladder function.

Intermittent catheterization is carried out to avoid overdistention of the bladder and high risk for UTI due to retention of urine. At an early stage, family members are shown how to carry out intermittent catheterization and are encouraged to participate in this facet of care, because they will be involved in long-term follow-up and must be able to recognize complications so that treatment can be instituted.

The patient is educated to record fluid intake, voiding pattern, amounts of residual urine after voiding, characteristics of urine, and any unusual sensations that may occur. For the management of a neurogenic bladder, training is essential. (See the following section for bladder training).

Improving Bowel Function

Immediately after SCI, a paralytic ileus usually develops as a result of neurogenic paralysis of the bowel; therefore, a nasogastric tube is often required to relieve distention and to prevent vomiting and aspiration (Rodriguez, 2016).

Bowel activity usually returns within the first week. With the intake of nutrition, it is important to establish a bowel program. A bowel program can help to control bowel movements by establishing a pattern of planned evacuation. The nurse administers prescribed combinations of stool softeners, stimulant laxatives, bulking laxatives, and rectal laxatives along with rectal stimulation, to counteract the effects of immobility and analgesic agents (Rodriguez, 2016).

Providing Comfort Measures: The Patient in Traction With Tongs or Halo Vest

A patient who has had pins, tongs, or calipers placed for cervical stabilization may have a headache or discomfort for several days after the pins are inserted. Patients initially may be bothered by the rather startling appearance of these devices, but usually they readily adapt to it because the device provides comfort for the unstable neck (see Fig. 51-8). The patient may complain of being caged in and of noise created by any object coming in contact with the frame of a halo device, but they can be reassured that adaptation will occur.

The areas around the four pin sites of a halo device are cleaned at least daily and observed for redness, drainage, and pain. The pins are observed for loosening, which may contribute to infection. If one of the pins becomes detached, the head is stabilized in a neutral position by one person, while another notifies the primary provider. A torque screwdriver should be readily available in case the screws on the frame need tightening.

The skin under the halo vest is inspected for excessive perspiration, redness, and skin blistering, especially on the bony prominences. The vest is opened at the sides to allow the torso to be washed. The liner of the vest should not become wet, because dampness causes skin excoriation. Powder is not used inside the vest, because it may contribute to the development of pressure ulcers. The liner should be changed periodically to promote hygiene and good skin care. If the patient is to be discharged with the vest, detailed instructions must be given to the family, with time allowed for them to demonstrate the necessary skills of halo vest care (see Chart 51-8).

Recognizing Autonomic Dysreflexia

Autonomic dysreflexia, also known as autonomic hyperreflexia, is an acute life-threatening emergency that occurs as a result of exaggerated autonomic responses to stimuli that are harmless in people without SCI. It occurs only after spinal shock has resolved. This syndrome is characterized by a severe, pounding headache with paroxysmal hypertension, profuse diaphoresis above the spinal level of the lesion (most often of the forehead), nausea, nasal congestion, and bradycardia. It occurs among patients with cord lesions above T6 (the sympathetic visceral outflow level) after spinal shock has subsided (Bader et al., 2016). The sudden increase in blood pressure may cause retinal hemorrhage, hemorrhagic stroke, myocardial infarction, or seizures (Hickey, 2014). A number of stimuli may trigger this reflex: distended bladder (the most common cause); distention or contraction of the visceral organs, especially the bowel (from constipation, impaction); or stimulation of the skin (tactile, pain, thermal stimuli, pressure ulcer). Because this is an emergency situation, the objectives are to remove the triggering stimulus and to avoid the possibility of serious complications (Wan & Krassioukov, 2014).

The following measures are carried out:

- The patient is placed immediately in a sitting position to lower blood pressure.
- Rapid assessment is performed to identify and alleviate the cause.
- The bladder is emptied immediately via a urinary catheter. If an indwelling catheter is not patent, it is irrigated or replaced with another catheter.
- The rectum is examined for a fecal mass. If one is present, a topical anesthetic agent is inserted 10 to 15 minutes before the mass is removed, because visceral distention or contraction can cause autonomic dysreflexia.
- The skin is examined for any areas of pressure, irritation, or broken skin.
- Any other stimulus that could be the triggering event, such as an object next to the skin or a draft of cold air, must be removed.
- If these measures do not relieve the hypertension and excruciating headache, antihypertensive medications may be prescribed and given slowly by the IV route.

Chart 51-8 HOME CARE CHECKLIST

The Patient with a Halo Vest

At the completion of education, the patient and/or caregiver will be able to:

- Name the procedure that was performed and identify any permanent changes in anatomic structure or function as well as changes in ADLs, IADLs, roles, relationships, and spirituality.
- Describe the rationale for the use of the halo vest.
- State how to contact all members of the treatment team (e.g., health care providers, home care professionals, rehabilitation team, and durable medical equipment and supply vendor).
- State changes in lifestyle (e.g., diet, ADLs, IADLs, activity) necessary for recovery and health maintenance, as applicable.
  - Demonstrate safe techniques to assist the patient with self-care, hygiene, and ambulation.
  - Demonstrate assessment of frame, traction, tongs, and pins.
  - Demonstrate pin care using correct technique.
  - Demonstrate care of skin, including assessment (e.g., reddened or irritated areas, breakdown).
  - Identify signs and symptoms of infection.
  - Explain the reasons for and the method for changing the vest liner.
  - Identify holistic measures of pain management.
- Identify signs and symptoms of complications (e.g., venous thromboembolism, respiratory impairment, urinary tract infection).
- Describe emergency measures if respiratory or other complications develop while the patient is in the halo vest or if the frame becomes dislodged.
- Relate how to reach primary provider with questions or complications.
- State time and date of follow-up medical appointments, therapy, and testing.
- Identify sources of support (e.g., friends, relatives, faith community, spinal cord injury support groups, caregiver support).
- Identify the need for health-promotion, disease prevention, and screening activities.

ADLs, activities of daily living; IADLs, independent activities of daily living.

- The medical record is labeled with a clearly visible note about the risk of autonomic dysreflexia.
- The patient is instructed about prevention and management measures.
- Any patient with a lesion above the T6 segment is informed that such an episode is possible and may occur even many years after the initial injury (Bader et al., 2016).

Monitoring and Managing Potential Complications

Patients are at high risk for VTE after SCI. The patient must be assessed for symptoms of VTE including DVT and PE. Chest pain, shortness of breath, and changes in arterial blood gas values must be reported promptly to the primary provider. The circumferences of the thighs and calves are measured and recorded daily; further diagnostic studies are performed if a significant increase is noted. Patients remain at high risk for thrombophlebitis for several months after the initial injury. Patients with paraplegia or tetraplegia are at increased risk for the rest of their lives. Immobilization and the associated venous stasis, as well as varying degrees of autonomic disruption, contribute to the high risk and susceptibility for DVT.

Anticoagulation should be initiated within 72 hours of injury and continued for at least 3 months (Jia et al., 2013). The use of low–molecular-weight heparin or low-dose unfractionated heparin may be followed by long-term oral anticoagulation (i.e., warfarin [Coumadin]). Additional measures such as range-of-motion exercises, antiembolism stockings, and adequate hydration are important preventive measures. SCDs may also be used to reduce venous pooling and promote venous return. It is also important to avoid external pressure on the lower extremities that may result from flexion of the knees while the patient is in bed.

Orthostatic Hypotension. For the first 2 weeks after SCI, the blood pressure tends to be unstable and can be quite low. It gradually returns to preinjury levels, but periodic episodes of severe orthostatic hypotension frequently interfere with efforts to mobilize the patient. Interruption in the reflex arcs that normally produce vasoconstriction in the upright position, coupled with vasodilation and pooling in abdominal and lower extremity vessels, can result in hypotension. Orthostatic hypotension is a particularly common problem for patients with lesions above T7. In some patients with tetraplegia, even slight elevations of the head can result in blood pressure dysregulation.

A number of techniques can be used to reduce the frequency of hypotensive episodes. Close monitoring of vital signs before and during position changes is essential. Optimization of fluid status and vasopressor medication can be used to treat the profound vasodilation. Antiembolism stockings should be applied to improve venous return from the lower extremities. Abdominal binders may also be used to encourage venous return and provide diaphragmatic support when the patient is upright (Bader et al., 2016); (Mills, Fung, Travios, et al., 2015). Activity should be planned in advance, and adequate time should be allowed for a slow progression of position changes from recumbent to sitting and upright. Tilt tables frequently are helpful in assisting patients to make this transition.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. In most cases, patients with SCI (i.e., patients with tetraplegia or paraplegia) need long-term rehabilitation. The process begins during hospitalization as acute symptoms begin to subside or come under better control and the overall deficits and long-term effects of the injury become clear. The goals begin to shift from merely surviving the injury to learning strategies necessary to cope with the alterations that the injury imposes on activities of daily living (ADLs). The emphasis shifts from ensuring that the patient is stable and free of complications to specific assessment and planning designed to meet the patient's rehabilitation needs. Patient education may initially focus on the injury and its effects on mobility; dressing; and bowel, bladder, and sexual function. As the patient and family acknowledge the consequences of the injury and the resulting disability, the focus of education broadens to address issues necessary for carrying out the tasks of daily living and taking charge of their lives. Education must begin in the acute phase and continue throughout rehabilitation and the patient's entire life as changes occur, the patient ages, and problems arise (Bader et al., 2016).

Caring for the patient with SCI at home may at first seem a daunting task to the family. They will require dedicated nursing support to gradually assume full care of the patient. Although maintaining function and preventing complications will remain important, goals regarding self-care and preparation for discharge will assist in a smooth transition to rehabilitation and eventually to the community.

Continuing and Transitional Care. The goal of the rehabilitation process is independence. The nurse becomes a support to both the patient and the family, assisting them to assume responsibility for increasing aspects of patient care and management. Care for the patient with SCI involves members of all health care disciplines, which may include nursing, medicine, rehabilitation, respiratory therapy, physical and occupational therapy, case management, and social services. The nurse often serves as coordinator of the management team and as a liaison with rehabilitation centers and home care agencies. The patient and family often require assistance in dealing with the psychological impact of the injury and its consequences; referral to a psychiatric clinical nurse specialist or other mental health care professional often is helpful. Therapeutic horseback riding may help increase balance, muscle strength, and self-esteem (Asselin, Ward, Penning, et al., 2012).

The nurse should reassure female patients with SCI that pregnancy is not contraindicated and fertility is relatively unaffected, but that pregnant women with acute or chronic SCI pose unique management challenges. The normal physiologic changes of pregnancy may predispose women with SCI to many potentially life-threatening complications, including autonomic dysreflexia, pyelonephritis, respiratory insufficiency, thrombophlebitis, PE, and unattended delivery. Preconception assessment and counseling are strongly recommended to ensure that the woman is in optimal health and to increase the likelihood of an uneventful pregnancy and healthy outcomes (Pebdani, Johnson, & Amtmann, 2014).

As more patients survive acute SCI, they face the changes associated with aging with a disability. Three common secondary health problems experienced by persons living with SCI include chronic pain, spasticity, and depression (Abrams & Wakasa, 2014); (Saunders, Clarke, Tate, et al., 2015). Education in the home and community focuses on health promotion and addresses the need to minimize risk factors (e.g., smoking, alcohol and drug abuse, obesity). Routine health screening and preventive services are needed for the older adult with SCI for early detection of secondary health problems. Home care nurses and others who have contact with patients with SCI are

in a position to educate patients about healthy lifestyles, remind them of the need for health screenings, and make referrals as appropriate. Assisting patients to identify accessible health care providers, clinical facilities, and imaging centers may increase the likelihood that they will participate in health screening.

Evaluation

Expected patient outcomes may include:

1. Demonstrates improvement in gas exchange and clearance of secretions, as evidenced by normal breath sounds on auscultation
   a. Breathes easily without shortness of breath
   b. Performs hourly deep breathing exercises, coughs effectively, and clears pulmonary secretions
   c. Is free of respiratory infection (e.g., has temperature, respiratory rate, and pulse within normal limits; breath sounds clear to auscultation; absence of purulent sputum)
2. Moves within limits of the dysfunction and demonstrates completion of exercises within functional limitations
3. Avoids injury due to sensory, motor, and perceptual alterations
   a. Uses assistive devices (e.g., glasses, hearing aids, computers) as indicated
   b. Describes sensory, motor, and perceptual alterations as a consequence of injury
4. Demonstrates optimal skin integrity
   a. Exhibits normal skin turgor; skin is free of reddened areas or breaks
   b. Participates in skin care and monitoring procedures within functional limitations
5. Regains urinary bladder function
   a. Exhibits no signs of UTI (e.g., has temperature within normal limits; voids clear, dilute urine)
   b. Has adequate fluid intake
   c. Participates in bladder training program within functional limitations
6. Regains bowel function
   a. Reports regular pattern of bowel movement
   b. Consumes adequate dietary fiber and oral fluids
   c. Participates in bowel training program within functional limitations
7. Reports absence of pain and discomfort
8. Recognizes manifestations of autonomic dysreflexia if they occur (e.g., headache, diaphoresis, nasal congestion, bradycardia, or diaphoresis)
9. Is free of complications
   a. Demonstrates no signs of thrombophlebitis, DVT, or PE
   b. Maintains blood pressure within normal limits
   c. Reports no lightheadedness with position changes

Medical Management of Long-Term Complications of Spinal Cord Injury

The patient faces a lifetime of disability, requiring ongoing follow-up and care. The expertise of a number of health professionals, including physicians, rehabilitation nurses, occupational therapists, physical therapists, psychologists, social workers, rehabilitation engineers, and vocational counselors, is necessary at different times as the need arises.

The patient with an SCI has a shorter life expectancy compared to those who have not had an SCI (Abrams & Wakasa, 2014). As patients with SCI age, they have many of the same medical problems as others. In addition, they face the threat of complications associated with their disability (Hickey, 2014). Usually, patients are encouraged to follow-up at an outpatient spinal cord clinic when complications and other issues arise. Lifetime care includes assessment of the urinary tract at prescribed intervals, because there is the likelihood of continuing alteration in detrusor and sphincter function, and the patient is prone to UTI (Abrams & Wakasa, 2014).

Long-term problems and complications of SCI include disuse syndrome, autonomic dysreflexia (discussed earlier), bladder and kidney infections, spasticity, and depression (Abrams & Wakasa, 2014). Pressure ulcers with potential complications of sepsis, osteomyelitis, and fistulas occur in about 10% of patients. Spasticity may be particularly disabling. Heterotopic ossification (overgrowth of bone) in the hips, knees, shoulders, and elbows occurs in many patients after SCI. Spasticity and heterotopic ossification of these complications are painful and can produce a loss of range of motion (Abrams & Wakasa, 2014). Management includes observing for and addressing any alteration in physiologic status and psychological outlook, as well as the prevention and treatment of long-term complications. The nursing role involves emphasizing the need for vigilance in self-assessment and care.

NURSING PROCESS

The Patient with Tetraplegia or Paraplegia

Assessment

Assessment focuses on the patient's general condition, complications, and how the patient is managing at that particular point in time. A head-to-toe assessment and review of systems should be part of the database, with emphasis on the areas that are prone to problems in this population. A thorough inspection of all areas of the skin for redness or breakdown is critical. The nurse reviews the established bowel and bladder program with the patient, because the program must continue uninterrupted. Patients with tetraplegia or paraplegia have varying degrees of loss of motor power, deep and superficial sensation, vasomotor control, bladder and bowel control, and sexual function. They are faced with potential complications related to immobility, skin breakdown and pressure ulcers, recurring UTIs, and contractures. Knowledge about these particular issues can further guide the assessment in any setting. Nurses in all settings, including home care, must be aware of these potential complications in the lifetime management of these patients.

An understanding of the emotional and psychological responses to tetraplegia or paraplegia is achieved by observing the responses and behaviors of the patient and family and by listening to their concerns (Chuang, Yang, & Kuo, 2015). Documenting these assessments and reviewing the plan with the entire team on a regular basis provide insight into how both the patient and the family are coping with the changes in lifestyle and body functioning. Additional information frequently can be gathered from the social worker or psychiatric/mental health worker.

It takes time for the patient and family to comprehend the magnitude of the disability. They may go through stages of grief, including shock, disbelief, denial, anger, depression, and acceptance. During the acute phase of the injury, denial can be a protective mechanism to shield the patient from the

acute reality of what has happened. As the patient realizes the permanent nature of paraplegia or tetraplegia, the grieving process may be prolonged and all-encompassing because of the recognition that long-held plans and expectations are interrupted or permanently altered. A period of depression often follows as the patient experiences a loss of self-esteem in areas of self-identity, sexual functioning, and social and emotional roles. Exploration and assessment of these issues can assist in developing a meaningful plan of care.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Impaired bed and physical mobility related to loss of motor function
- Risk for disuse syndrome
- Risk for impaired skin integrity related to permanent sensory loss and immobility
- Impaired urinary elimination related to level of injury
- Constipation related to effects of spinal cord disruption
- Sexual dysfunction related to neurologic dysfunction
- Ineffective coping related to impact of disability on daily living
- Deficient knowledge about requirements for long-term management

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Spasticity
- Infection and sepsis

Planning and Goals

The goals for the patient may include attainment of some form of mobility; maintenance of healthy, intact skin; achievement of bladder management without infection; achievement of bowel control; achievement of sexual expression; strengthening of coping mechanisms; knowledge of long-term management; and absence of complications.

Nursing Interventions

The patient requires extensive rehabilitation, which is less difficult if appropriate nursing management has been carried out during the acute phase of the injury or illness. Nursing care is one of the key factors determining the success of the rehabilitation program. The main objective is for the patient to live as independently as possible in the home and community.

Increasing Mobility

Exercise Programs. The unaffected parts of the body are built up to optimal strength to promote maximal self-care. The muscles of the hands, arms, shoulders, chest, spine, abdomen, and neck must be strengthened in the patient with paraplegia, because they must bear full weight on these muscles to ambulate. The triceps and the latissimus dorsi are important muscles used in crutch walking. The muscles of the abdomen and the back also are necessary for balance and for maintaining the upright position.

To strengthen these muscles, the patient can do push-ups when in a prone position and sit-ups when in a sitting position. Extending the arms while holding weights (traction weights can be used) also develops muscle strength. Squeezing rubber balls or crumbling newspaper promotes hand strength.

With encouragement from all members of the rehabilitation team, the patient with paraplegia can develop the increased exercise tolerance needed for gait training and ambulation activities. The importance of maintaining cardiovascular fitness is stressed to the patient. Alternative exercises to increase the heart rate to target levels must be designed within the patient's abilities.

Mobilization. After the spine is stable enough to allow the patient to assume an upright posture, mobilization activities are initiated. A brace or vest may be used, depending on the level of the lesion. The sooner muscles are used, the less chance there is of disuse atrophy. The earlier the patient is brought to a standing position, the less opportunity there is for osteoporotic changes to take place in the long bones. Weight bearing also reduces the possibility of renal calculi and enhances many other metabolic processes.

Braces and crutches enable some patients with paraplegia to ambulate for short distances. Ambulation using crutches requires a high expenditure of energy. Motorized wheelchairs and specially equipped vans can provide greater independence and mobility for patients with high-level SCI or other lesions. Every effort should be made to encourage the patient to be as mobile and active as possible.

Long-term risks include altered body composition, a decrease in lean body mass, decreased bone mineral density, and increased BMI. Patients are at high risk for obesity due to high fat intake combined with decreased physical activity (Lieberman, Goff, Hammond, et al., 2014). This puts patients at higher risk of developing comorbid conditions such as diabetes and cardiovascular disease. Patients benefit from nutrition counseling to prevent these secondary complications. For those who are overweight or who have obesity, weight-loss programs must be designed to accommodate the dietary and physical activity barriers that are unique to this population (Lieberman et al., 2014).

Preventing Disuse Syndrome

Patients are at high risk for development of contractures as a result of disuse syndrome due to the musculoskeletal system changes (atrophy) brought about by the loss of motor and sensory functions below the level of injury. Range-of-motion exercises must be provided at least four times a day, and care is taken to stretch the Achilles tendon with exercises, to prevent footdrop. The patient is repositioned frequently and is maintained in proper body alignment whether in bed or in a wheelchair.

Contractures can complicate day-to-day care, increasing the difficulty of positioning and decreasing mobility. A number of surgical procedures have been tried, with varying degrees of success. These techniques are used if more conservative approaches fail, but the best treatment is prevention.

Promoting Skin Integrity

Because these patients spend a great portion of their lives in wheelchairs, pressure ulcers are an ever-present threat. Contributing factors are permanent sensory loss over pressure areas; immobility, which makes relief of pressure difficult; trauma from bumps (against the wheelchair, toilet, furniture, and so forth) that cause unnoticed abrasions and wounds; loss of protective function of the skin from excoriation and maceration due to excessive perspiration and possible incontinence; and poor general health (anemia, diabetes), leading to poor tissue perfusion.

The person with tetraplegia or paraplegia must take responsibility for monitoring (or directing monitoring) of their skin status. This involves relieving pressure and not remaining in any position for longer than 2 hours, in addition to ensuring that the skin receives meticulous attention and cleansing (Bader et al., 2016). The patient is educated that ulcers develop over bony prominences that are exposed to unrelieved pressure in the sitting and lying positions. The most vulnerable areas are identified. The patient with paraplegia is instructed to use mirrors, if possible, to inspect these areas morning and night, observing for redness, slight edema, or any abrasions. While in bed, the patient should turn at 2-hour intervals and then inspect the skin again for redness that does not fade on pressure. The bottom sheet should be checked for wetness and for creases. The patient with tetraplegia or paraplegia, who cannot perform these activities, is encouraged to direct others to check these areas and prevent ulcers from developing.

The patient is educated to relieve pressure while in the wheelchair by doing push-ups, leaning from side to side to relieve ischial pressure, and tilting forward while leaning on a table. The caregiver for the patient with tetraplegia will need to perform these activities if the patient cannot do so independently. A wheelchair cushion is prescribed to meet individual needs, which may change in time with changes in posture, weight, and skin tolerance. A referral can be made to a rehabilitation engineer, who can measure pressure levels while the patient is sitting and then tailor the cushion and other necessary aids and assistive devices to the patient's needs.

The diet for the patient with tetraplegia or paraplegia should be high in protein, vitamins, and calories to ensure minimal wasting of muscle and the maintenance of healthy skin, and high in fluids to maintain well-functioning kidneys. Excessive weight gain and obesity should be avoided, because they further limit mobility.

Improving Bladder Management

The effect of the spinal cord lesion on the bladder depends on the level of injury, the degree of cord damage, and the length of time after injury. A patient with tetraplegia or paraplegia usually has either a reflex or a nonreflex bladder. Both bladder types increase the risk of UTI.

The nurse emphasizes the importance of maintaining an adequate flow of urine by encouraging a fluid intake of about 2.5 L daily. The patient should empty the bladder frequently so that there is minimal residual urine and should pay attention to personal hygiene, because infection of the bladder and kidneys almost always occurs by the ascending route. The perineum must be kept clean and dry, and attention must be given to the perianal skin after defecation. Underwear should be cotton (which is more absorbent) and should be changed at least once a day.

If an external catheter (condom catheter) is used, the sheath is removed nightly; the penis is cleansed to remove urine and is dried carefully, because warm urine on the periurethral skin promotes the growth of bacteria. Attention also is given to the collection bag. The nurse emphasizes the importance of monitoring for signs of UTI: cloudy, foul-smelling urine or hematuria (blood in the urine); fever; or chills.

The female patient who cannot achieve reflex bladder control or self-catheterization may need to wear pads or waterproof undergarments. Surgical intervention may be indicated in some patients to create a urinary diversion.

Establishing Bowel Control

The objective of a bowel training program is to establish bowel evacuation through reflex conditioning, (bowel training is discussed later in the chapter.)

If the SCI occurs above the sacral segments or nerve roots and there is reflex activity, the anal sphincter may be massaged (digital stimulation) to stimulate defecation. If the cord lesion involves the sacral segment or nerve roots, anal massage is not performed because the anus may be relaxed and lack tone. Massage is also contraindicated if there is spasticity of the anal sphincter. The anal sphincter is massaged by inserting a gloved finger (which has been adequately lubricated) 2.5 to 3.7 cm (1 to 1.5 inches) into the rectum and moving it in a circular motion or from side to side. It soon becomes apparent which area triggers the defecation response. This procedure should be performed at regular time intervals (usually every 48 hours), after a meal, and at a time that will be convenient for the patient at home (Rodriguez, 2016). The patient also is educated about the symptoms of impaction (frequent loose stools; constipation) and is cautioned to watch for hemorrhoids. A diet with sufficient fluids and fiber is essential to developing a successful bowel training program, avoiding constipation, and decreasing the risk of autonomic dysreflexia.

Counseling on Sexual Expression

Many patients with tetraplegia and paraplegia can have some form of meaningful sexual relationship, although modifications are necessary. The patient and partner benefit from counseling about the range of sexual expression possible, special techniques and positions, exploration of body sensations offering sensual feelings, and urinary and bowel hygiene as related to sexual activity. For men with erectile failure, penile prostheses enable them to have and sustain an erection, and impotence drugs may be helpful. Sildenafil (Viagra), vardenafil (Levitra), and tadalafil (Cialis), for example, are oral smooth muscle relaxants that cause blood to flow into the penis, resulting in an erection (see Chapter 46). Patients who are sexually active should undergo counseling in birth control methods, as some methods (e.g., oral contraceptives) may increase risks of complications such as VTE (Hickey, 2014).

Sexual education and counseling services are included in the rehabilitation services at spinal centers. Small group meetings in which patients can share their feelings, receive information, and discuss sexual concerns and practical aspects are helpful in producing effective attitudes and adjustments.

Enhancing Coping Mechanisms

The impact of the disability and loss becomes marked when the patient returns home. Each time something new enters the patient's life (e.g., a new relationship, going to work), the patient is reminded anew of their limitations. Grief reactions and depression are common.

To work through depression, the patient must have some hope for relief in the future. The nurse can encourage the patient to feel confident in their ability to achieve self-care and relative independence. The role of the nurse ranges from caretaker during the acute phase to educator, counselor, and facilitator as the patient gains mobility and independence.

The patient's disability affects not only the patient but also the entire family. In many cases, family therapy is helpful in working through issues as they arise. Adjustment to the disability leads to the development of realistic goals for the future, making the best of the abilities that are left intact, and reinvesting in other

activities and relationships. Rejection of the disability causes self-destructive neglect and nonadherence to the therapeutic program, which leads to more frustration and depression. Crises for which interventions may be sought include social, psychological, marital, sexual, and psychiatric problems. The family usually requires counseling, social services, and other support systems to help them cope with the changes in their lifestyle and socioeconomic status.

A major goal of nursing management is to help the patient overcome their sense of futility and to encourage the patient in the emotional adjustment that must be made before they are willing to venture into the outside world. However, an excessively sympathetic attitude on the part of the nurse may cause the patient to develop an overdependence that defeats the purpose of the entire rehabilitation program. The patient is educated and assisted when necessary, but the nurse should avoid performing activities that the patient can do independently with a little effort. This approach to care more than repays itself in the satisfaction of seeing a patient, who is completely demoralized and helpless, become independent and find meaning in a newly emerging lifestyle.

Monitoring and Managing Potential Complications

Spasticity. Muscle spasticity can be a problematic complication of tetraplegia and paraplegia. Flexor or extensor spasms occur below the level of the spinal cord lesion and can interfere with the rehabilitation process, ADLs, and quality of life (Abrams & Wakasa, 2014). Spasticity results from an imbalance between the facilitatory and inhibitory effects on neurons that exist normally. The area of the cord distal to the site of injury or lesion becomes disconnected from the higher inhibitory centers located in the brain, so facilitatory impulses, which originate from muscles, skin, and ligaments, predominate.

Spasticity is defined as a condition of increased muscle tone in a muscle that is weak. Initial resistance to stretching is quickly followed by sudden relaxation. The stimulus that precipitates spasm can be obvious, such as movement or a position change, or subtle, such as a slight jarring of the wheelchair. Most patients with tetraplegia or paraplegia have some degree of spasticity. Because it increases muscle tone, some degree of spasticity can be beneficial in patients who are weak (Abrams & Wakasa, 2014). With SCI, the onset of spasticity usually occurs from a few weeks to 6 months after the injury. The same muscles that are flaccid during the period of spinal shock develop spasticity during recovery. The intensity of spasticity tends to peak approximately 2 years after the injury, after which the spasms tend to regress.

Management of spasticity is based on the severity of symptoms and the degree of incapacitation. Botulinum toxin (Botox) injections, as well as the antispasmodic medication baclofen (Lioresal), available in an oral and an intrathecal form, may be indicated (Comerford et al., 2015). Oral medications such as diazepam (Valium), dantrolene (Dantrium), and tizanidine (Zanaflex) help control spasms by decreasing sympathetic outflow from the central nervous system. Other forms of adjunctive therapy include oral and transdermal forms of clonidine (Catapres) (Hickey, 2014). All of the antispasmodic medications cause drowsiness, weakness, and vertigo in some patients. Passive range-of-motion exercises and frequent turning and repositioning are helpful, because stiffness tends to increase spasticity. These activities also are essential in the prevention of contractures, pressure ulcers, and bowel and bladder dysfunction.

Infection and Sepsis. Patients with tetraplegia and paraplegia are at increased risk for infection and sepsis from a variety of sources: urinary tract, respiratory tract, and pressure ulcers. Sepsis remains a major cause of complications and death in these patients. Prevention of infection and sepsis is essential through maintenance of skin integrity, complete emptying of the bladder at regular intervals, and prevention of urinary and fecal incontinence. The risk of respiratory infection can be decreased by avoiding contact with people who have symptoms of respiratory infection, performing coughing and deep breathing exercises to prevent pooling of respiratory secretions, receiving yearly influenza vaccines, and giving up smoking. A high-protein diet is important in maintaining an adequate immune system, as is avoiding factors that may reduce immune system function, such as excessive stress, drug abuse, and excessive alcohol intake.

If infection occurs, the patient requires thorough assessment and prompt treatment. Antibiotic therapy and adequate hydration, in addition to local measures (depending on the site of infection), are initiated immediately.

UTIs are minimized or prevented by aseptic technique in catheter management, adequate hydration, a bladder training program, and prevention of overdistention of the bladder and urinary stasis.

Skin breakdown and infection are prevented by maintenance of a turning schedule; frequent back care; regular assessment of all skin areas; regular cleaning and lubrication of the skin; passive range-of-motion exercise to prevent contractures; pressure relief over broken skin areas, bony prominences, and heels; and wrinkle-free bed linen.

Pulmonary infections are managed and prevented by frequent coughing, turning, and deep breathing exercises and chest physiotherapy; aggressive respiratory care and suctioning of the airway if a tracheostomy is present; assisted coughing as needed; and adequate hydration.

Infections of any kind can be life threatening. Aggressive nursing interventions are key to prevention, detection, and early management.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. Patients with tetraplegia or paraplegia are at risk for complications for the rest of their lives. Therefore, a major aspect of nursing care is educating the patient and family about these complications and about strategies to minimize risks. UTIs, contractures, infected pressure ulcers, and sepsis may necessitate hospitalization. Other late complications that may occur include lower extremity edema, joint contractures, respiratory dysfunction, and pain. To avoid these and other complications, the patient and family members are educated about skin care, catheter care, range-of-motion exercises, breathing exercises, and other care techniques. Education is initiated as soon as possible and extends into the rehabilitation or long-term care facility and home. In all aspects of care, it is important for the nurse and patient to set mutual goals and discuss the tasks the patient is capable of doing independently and which tasks the patient needs assistance to complete.

Continuing and Transitional Care. Referral for home care is often appropriate for assessment of the home setting, patient education, and evaluation of the patient's physical and emotional status. During visits by the nurse, education about strategies to

prevent or minimize potential complications is reinforced. The home environment is assessed for adequacy of care and for safety. Environmental modifications are made, and specialized equipment is obtained, ideally before the patient goes home.

The nurse also assesses the patient's and the family's adherence to recommendations and their use of coping strategies. The use of inappropriate coping strategies (e.g., drug and alcohol use) is assessed, and referrals to counseling are made for the patient and family. Appropriate and effective coping strategies are reinforced. The nurse reviews previous education and determines the need for further physical or psychological assistance. The patient's self-esteem and body image may be very poor at this time. Because people with high levels of social support often report feelings of well-being despite major physical disability, it is beneficial for the nurse to assess and promote further development of the support system and effective coping strategies for each patient. Caregivers and peer mentors play a critical role in helping patients feel less dependent, experience feelings of freedom, and reintegrate into the community (Beauchamp, Scarlett, Ruissen, et al., 2016).

The patient requires continuing, lifelong follow-up by the primary provider, physical therapist, and other rehabilitation team members, because the neurologic deficit is usually permanent and new deficits, complications, and secondary conditions can develop. These require prompt attention before they take their toll in additional physical impairment, time, morale, and financial costs. Research suggests that education and peer mentoring may decrease complications following SCI (Abrams & Wakasa, 2014); (Beauchamp et al., 2016). The nurse is in a good position to remind patients and family members of the need for continuing health promotion and screening practices. Referral to accessible health care providers and imaging centers is important in health promotion and health screening.

Evaluation

Expected patient outcomes may include:

1. Attains maximum form of mobility
2. Contractures do not develop
3. Maintains healthy, intact skin
4. Achieves bladder control, absence of UTI
5. Achieves bowel control
6. Reports sexual satisfaction
7. Shows improved adaptation to environment and others
8. Exhibits reduction in spasticity
    a. Reports understanding of the precipitating factors
    b. Uses measures to reduce spasticity
9. Describes long-term management required
10. Exhibits absence of complications

Rehabilitation of Patients with Neurotrauma and Other Neurological Conditions

Patients who sustain head injury or spinal injury need extensive rehabilitative workup to meet the self-care demands and to prevent pressure ulcer and meet the bowel and bladder elimination needs. Other neurological conditions also need extensive rehabilitation workup to have ADL independence and to improve the quality of life.

NURSING PROCESS

The Patient with Impaired Skin Integrity

Pressure ulcers are localized areas of necrotic soft tissue that occur when pressure applied to the skin over time is greater than normal capillary closure pressure, which is about 32 mm Hg. Critically ill patients have a lower capillary closure pressure and a greater risk of pressure ulcers. Patients who are prone to pressure ulcers include those confined to bed for long periods, those with motor or sensory dysfunction, and those who experience muscular atrophy and reduction of padding between the overlying skin and the underlying bone (Sullivan & Schoelles, 2013). The Centers for Medicare and Medicaid Services (CMS) has recently implemented an Inpatient Rehabilitation Facility quality reporting measure related to the percentage of residents with new or worsened pressure ulcers. Based on data from the 2011 International Pressure Ulcer Prevalence Survey, the facility prevalence of pressures ulcers was 11.2% among all facilities surveyed (Wang, Niewczyk, DiVita, et al., 2014). As well as significant pain and suffering, the consequences of developing a pressure ulcer include increased morbidity and mortality and higher medical costs and resource use, and lower odds of discharge to the community.

The American Nurses Association tracks hospital-acquired pressure ulcers (HAPU) quarterly as part of the National Database of Nursing Quality Indicators® (NDNQI®). Between the years 2004 and 2011, there was a decreasing trend in the HAPU rate overall, with more improvement beginning in 2008 (He, Staggs, Bergquist-Beringer, et al., 2013). This improvement corresponds to the year the Agency for Healthcare Research and Quality (AHRQ) included data on pressure ulcers as a patient safety indicator in the Healthcare Cost and Utilization Project (HCUP) hospital database. Despite this decrease in overall HAPU rates, development of a pressure ulcer still presents a significant patient safety risk, with increased rates of patient death and longer hospital lengths of stays and readmissions (He et al., 2013). The average length of stay for hospitalizations related to pressure ulcers is 13.4 days, with an average treatment cost of nearly $20,000 for each affected patient (He et al., 2013). All possible efforts to prevent skin breakdown must be made because the treatment of pressure ulcers is costly in terms of health care dollars and quality of life for patients at risk.

The initial sign of pressure is erythema (redness of the skin) caused by reactive hyperemia, which normally resolves in less than 1 hour. Unrelieved pressure results in tissue ischemia or anoxia. The cutaneous tissues become broken or destroyed, leading to progressive destruction and necrosis of underlying soft tissue, and the resulting pressure ulcer is painful and slow to heal.

Assessment

Nursing assessment involves identifying and evaluating risk for development of pressure ulcers as well as assessment of the skin.

Assessment of Risk Factors

Immobility, impaired sensory perception or cognition, decreased tissue perfusion, decreased nutritional status, friction and shear forces, increased moisture, and age-related skin changes all contribute to the development of pressure ulcers (DiVita, Granger, Goldstein, et al., 2015); (García-Fernández, Agreda, Verdú, et al., 2014). Chart 51-9 lists risk factors for pressure ulcers. Scales such as the Braden scale (see Table 51-4) or Norton scale (Norton, McLaren, & Exton-Smith, 1962) may be used to facilitate systematic assessment and quantification

Chart 51-9 RISK FACTORS

Pressure Ulcers

- Prolonged pressure on tissue
- Immobility, compromised mobility
- Loss of protective reflexes, sensory deficit/loss
- Poor skin perfusion, edema
- Malnutrition, hypoproteinemia, anemia, vitamin deficiency
- Friction, shearing forces, trauma
- Incontinence of urine or feces
- Altered skin moisture: excessively dry, excessively moist
- Advanced age, debilitation
- Equipment: casts, traction, restraints
- Skin problems on admission

Adapted from DiVita, M. A., Granger, C. V., Goldstein, R., et al. (2015). Risk factors for development of new or worsened pressure ulcers among patients in inpatient rehabilitation facilities in the United States: Data from the Uniform Data System for Medical Rehabilitation. Physical Medicine & Rehabilitation, 7(6), 599–612; Dunk, A. M., & Carville, K. (2015). The international clinical practice guideline for prevention and treatment of pressure ulcers/injuries. Journal of Advanced Nursing, n/a-n/a. doi: 10.1111/jan.12614; García-Fernández, F. P., Agreda, J., Verdú, J., et al. (2014). A new theoretical model for the development of pressure ulcers and other dependence-related lesions. Journal of Nursing Scholarship, 46(1), 28–38; Stifter, J., Yao, Y., Lodhi, M. K., et al. (2015). Nurse continuity and hospital-acquired pressure ulcers. Nursing Research, 64(5), 361–371.

of a patient's risk for pressure ulcer, although the nurse should recognize that the reliability of these scales is not well established for all patient populations.

Specific nursing actions related to assessing risk include:

- Evaluate level of mobility.
- Note safety and assistive devices (e.g., restraints, splints).
- Assess neurovascular status.
- Evaluate circulatory status (e.g., peripheral pulses, edema).
- Note present health problems.
- Evaluate nutritional and hydration status.
- Review the results of the patient's laboratory studies, including hematocrit, hemoglobin, electrolytes, albumin, prealbumin, transferrin, and creatinine.
- Determine presence of incontinence.
- Review current medications.

Nursing Alert: Pressure ulcers are associated with increased costs of treatment and length of hospital stay as well as diminished quality of life for patients. It is imperative that nurses perform a skin assessment on every patient admitted to a hospital, inpatient rehabilitation facility, or skilled nursing facility.

Immobility. When a person is immobile and inactive, pressure is exerted on the skin and subcutaneous tissue by objects on which the person rests, such as a mattress, chair seat, or cast. The development of pressure ulcers is directly related to the duration of immobility: If pressure continues long enough, small vessel thrombosis and tissue necrosis occur and a pressure ulcer results. Weight-bearing bony prominences are most susceptible to pressure ulcer development because they are covered only by skin and small amounts of subcutaneous tissue. Susceptible areas include the sacrum and coccygeal areas, ischial tuberosities (especially in people who sit for prolonged periods), greater trochanter, heel, knee, malleolus, medial condyle of the tibia, fibular head, scapula, and elbow (see Fig. 51-9).

Impaired Sensory Perception or Cognition. Patients with sensory loss, impaired level of consciousness, or paralysis may not be aware of the discomfort associated with prolonged pressure on the skin and therefore may not change their positions to relieve the pressure. This prolonged pressure impedes blood flow, reducing nourishment of the skin and underlying tissues. A pressure ulcer may develop in a short period of time.

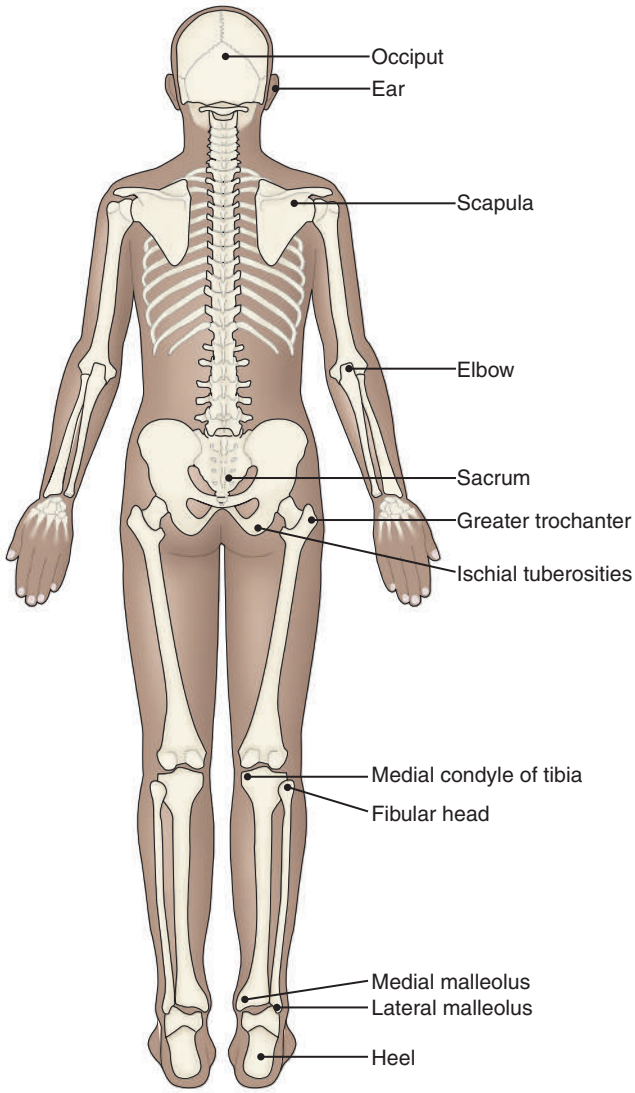


Figure 51-9 • Areas susceptible to pressure ulcers.

Decreased Tissue Perfusion. Any condition that reduces the circulation and nourishment of the skin and subcutaneous tissue (altered peripheral tissue perfusion) increases the risk of pressure ulcer development. Patients with diabetes have compromised microcirculation. Similarly, patients with edema have impaired circulation and poor nourishment of the skin tissue. Patients who are obese have large amounts of poorly vascularized adipose tissue, which is susceptible to breakdown.

Nutritional Status. Nutritional deficiencies, anemias, and metabolic disorders also contribute to the development of pressure ulcers. Anemia, regardless of its cause, decreases the blood's oxygen-carrying ability and predisposes the patient to pressure ulcers. Poor nutritional status can prolong the inflammatory phase of pressure ulcer healing and can reduce the quality and strength of wound healing (Thomas, 2015). Serum albumin and prealbumin levels are sensitive indicators of

TABLE 51-4 Braden Scale for Predicting Pressure Ulcer Risk

Patient's Name _____ Evaluator's Name _____ Date of Assessment _____								
Sensory Perception Ability to respond meaningfully to pressure-related discomfort	1. Completely Limited: Unresponsive (does not moan, flinch, or grasp) to painful stimuli, due to diminished level of consciousness or sedation OR limited ability to feel pain over most of body.	2. Very Limited: Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness OR has a sensory impairment that limits the ability to feel pain or discomfort over half of body.	3. Slightly Limited: Responds to verbal commands, but cannot always communicate discomfort or the need to be turned. OR has some sensory impairment that limits ability to feel pain or discomfort in one or two extremities.	4. No Impairment: Responds to verbal commands. Has no sensory deficit that would limit ability to feel or voice pain or discomfort.				
Moisture Degree to which skin is exposed to moisture	1. Constantly Moist: Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.	2. Very Moist: Skin is often, but not always, moist. Linen must be changed at least once a shift.	3. Occasionally Moist: Skin is occasionally moist, requiring an extra linen change approximately once a day.	4. Rarely Moist: Skin is usually dry, linen only requires changing at routine intervals.				
Activity Degree of physical activity	1. Bedfast: Confined to bed.	2. Chairfast: Ability to walk severely limited or nonexistent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	3. Walks Occasionally: Walks occasionally during day, but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.	4. Walks Frequently: Walks outside room at least twice a day and inside room at least once every 2 hours during waking hours.				
Mobility Ability to change and control body position	1. Completely Immobile: Does not make even slight changes in body or extremity position without assistance.	2. Very Limited: Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	3. Slightly Limited: Makes frequent though slight changes in body or extremity position independently.	4. No Limitation: Makes major and frequent changes in position without assistance.				
Nutrition Usual food intake pattern	1. Very Poor: Never eats a complete meal. Rarely eats more than a 1/3 of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement OR is NPO and/or maintained on clear liquids or IVs for more than 5 days.	2. Probably Inadequate: Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only 3 servings of meat or dairy products per day. Occasionally will take a dietary supplement OR receives less than optimum amount of liquid diet or tube feeding.	3. Adequate: Eats half of most meals. Eats a total of 4 servings of protein (meat, dairy products) per day. Occasionally will refuse a meal, but will usually take a supplement when offered OR is on a tube feeding or TPN regimen, which probably meets most of nutritional needs.	4. Excellent: Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.				
Friction and Shear	1. Problem: Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractures, or agitation leads to almost constant friction.	2. Potential Problem: Moves feebly or requires minimum assistance. During a move, skin probably slides to some extent against sheets, chair, restraints, or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	3. No Apparent Problem: Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair.					
				Total Score				

NPO, nothing by mouth; TPN, total parenteral nutrition.

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protein deficiency. Serum albumin levels of less than 3 g/dL are associated with hypoalbuminemic tissue edema and increased risk of pressure ulcers. Prealbumin levels are more sensitive indicators of protein status than albumin levels, but they are more costly to assess. The nurse should assess the patient's prealbumin and albumin values and electrolyte panel.

Friction and Shear. Mechanical forces also contribute to the development of pressure ulcers. Friction is the force of rubbing two surfaces against one another and is often caused by pulling a patient over a bed sheet (commonly known as sheet burn) or from a poorly fitted prosthetic device. Shear is the result of gravity pushing down on the patient's body and the resistance between the patient and the chair or bed (National Pressure Ulcer Advisory Panel, 2014). When shear occurs, tissue layers slide over one another, blood vessels stretch and twist, and the microcirculation of the skin and subcutaneous tissue is disrupted. Evidence of deep tissue damage may be slow to develop and may present through the development of a sinus tract, which is an area of destroyed tissue that extends from the edge of a wound. The sacrum and heels are most susceptible to the effects of shear. Pressure ulcers from friction and shear occur when the patient slides down in bed (see Fig. 51-10) or when the patient is positioned or moved improperly (e.g., dragged up in bed). Spastic muscles and paralysis increase the patient's vulnerability to pressure ulcers related to friction and shear.

Increased Moisture. Prolonged contact with moisture from perspiration, urine, feces, or drainage produces maceration (softening) of the skin. The skin reacts to caustic substances in the excreta or drainage and becomes irritated. Moist, irritated skin is more vulnerable to pressure breakdown. Once the skin breaks, the area is invaded by microorganisms (e.g., streptococci, staphylococci, *Pseudomonas aeruginosa, Escherichia coli*), and infection occurs. Foul-smelling infectious drainage is present. The lesion may enlarge and allow a continuous loss of serum, which may further deplete the body of essential protein needed for tissue repair and maintenance. The lesion may continue to enlarge and extend deep into the fascia, muscle, and bone, with multiple sinus tracts radiating from the pressure ulcer. With extensive pressure ulcers, life-threatening infections and sepsis may develop, frequently from gram-negative organisms.

Gerontologic Considerations. In older adults, the normal aging process leads to diminished epidermal thickness, dermal collagen, and tissue elasticity. The skin is drier as a result of diminished sebaceous and sweat gland activity. Cardiovascular changes result in decreased tissue perfusion. Muscles atrophy and bone structures become prominent. Diminished sensory perception and reduced ability to reposition oneself contribute to prolonged pressure on the skin. Therefore, older adults are more susceptible to pressure ulcers, which cause pain, suffering, and reduced quality of life.

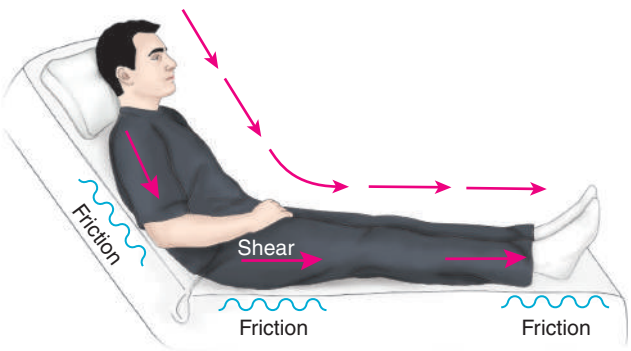


Figure 51-10 • Mechanical forces contribute to pressure ulcer development. As the person slides down or is improperly pulled up in bed, friction resists this movement. Shear occurs when one layer of tissue slides over another, disrupting microcirculation of skin and subcutaneous tissue.

Bariatric Considerations. In 2014, an international collaborative comprising members from the U.S. National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP), and the PanPacific Pressure Advisory Panel (PPPUAP) released the *Prevention and Treatment of Pressure Ulcers; Clinical Practice Guideline* (Dunk & Carville, 2015); (National Pressure Ulcer Advisory Panel, 2014). These updated guidelines include recommendations for adults who are obese with specific organization-level considerations, recommendations for the bariatric individual, as well as recommendations for bed and equipment selection and repositioning. Please see the NPUAP Web site link at the end of this chapter to review the quick reference guideline.

Assessment of Skin and Existing Ulcers

In addition to assessing risk, nursing actions to assess skin include:

- Assess total skin condition at least twice a day.
- Inspect each pressure site for erythema.
- Assess areas of erythema for blanching response.
- Palpate the skin for increased warmth.
- Inspect for dry skin, moist skin, and breaks in skin.
- Note drainage and odor.

If a pressure ulcer is seen, the nurse documents its size and location and uses a grading system to describe severity and provides a description of the site (see Chart 51-10). The appearance of purulent drainage or foul odor suggests an infection. With an extensive pressure ulcer, deep pockets of infection are often present. Drying and crusting of exudate may be present. Infection of a pressure ulcer may advance to osteomyelitis, pyarthrosis (pus formation within a joint cavity), sepsis, and septic shock.

Nursing Diagnosis

Based on the assessment data, nursing diagnoses may include the following:

- Risk for impaired skin integrity
- Impaired skin integrity related to immobility, decreased sensory perception, decreased tissue perfusion, decreased nutritional status, friction and shear forces, excessive moisture, or advanced age

Planning and Goals

The major goals may include relief of pressure, improved mobility, improved sensory perception, improved tissue perfusion, improved nutritional status, minimized friction and shear forces, dry surfaces in contact with skin, and healing of pressure ulcer, if present.

Nursing Interventions

Relieving Pressure

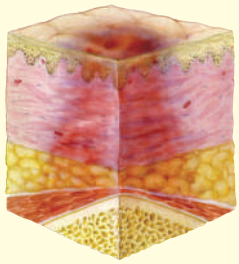
Frequent changes of position are needed to relieve and redistribute the pressure on the patient's skin and to promote blood flow to the skin and subcutaneous tissues. This can be accomplished by instructing the patient to change position or by turning and repositioning the patient. The patient's family members should be educated about how to position and turn

Chart 51-10

Stages in the Development of Pressure Ulcers

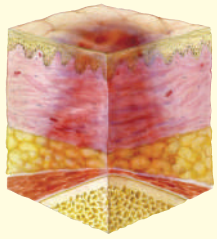
Suspected Deep Tissue Injury

- There may be a purple or maroon localized area of discolored intact skin or blood-filled blister.
- The area may be preceded in appearance by tissue that is painful, firm, mushy, boggy, and warmer or cooler as compared to adjacent tissue.
- Evolution may include a thin blister over a dark wound bed.
- The wound may further evolve and become covered by thin eschar.
- Evolution may be rapid, exposing additional layers of tissue even with optimal treatment.



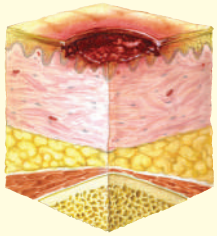
Stage I

- Intact skin
- Nonblanchable redness of a localized area, usually over a bony prominence
- Darkly pigmented skin may not have visible blanching.
- Color may differ from surrounding area.
- Area may be painful, firm, soft, and warmer or cooler as compared to adjacent tissue.



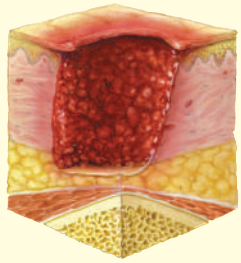
Stage II

- Partial thickness loss of dermis, presenting as a shallow open ulcer with red-pink wound bed without slough
- May present as an intact or open/ruptured serum-filled blister
- May present as a shiny or dry shallow ulcer without slough or bruising; bruising indicates suspected deep tissue injury
- Does not include skin tears, tape burns, perineal dermatitis, maceration, or excoriation



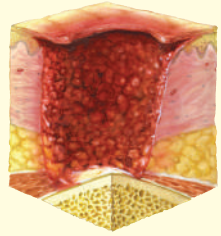
Stage III

- Full-thickness tissue loss
- Subcutaneous fat may be visible; however, bone, tendon, or muscle is not exposed.
- Slough may be present but does not obscure the depth of tissue loss.
- May include undermining and tunneling
- Depth of a stage III pressure ulcer varies by anatomic location. The bridge of the nose, ear, occiput, and malleolus do not have subcutaneous tissue; stage III ulcers can be shallow in these areas. Areas of significant adiposity can develop extremely deep stage III pressure ulcers.



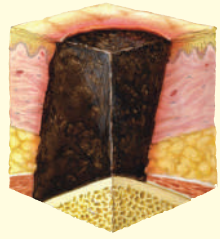
Stage IV

- Ulcer presents with full-thickness tissue loss with exposed bone, tendon, or muscle.
- Slough or eschar may be present on some parts of the wound.
- Often includes undermining and tunneling
- Depth of a stage IV pressure ulcer varies by anatomic location. The bridge of the nose, ear, occiput, and malleolus do not have subcutaneous tissue; stage IV ulcers can be shallow in these areas. Stage IV ulcers can extend into muscle and/or supporting structures (e.g., fascia, tendon, or joint capsule); osteomyelitis is possible. Exposed bone/tendon is visible or directly palpable.



Unstageable

- Full-thickness tissue loss in which the base of the ulcer is covered by slough (yellow, tan, gray, green, or brown) and/or eschar (tan, brown, or black) in the wound bed
- Until enough slough and/or eschar is removed to expose the base of the wound, the true depth, and therefore stage, cannot be determined.
- Stable (dry, adherent, intact without erythema or fluctuance) eschar on the heels serves as "the body's natural (biological) cover" and should not be removed.



Adapted from Peirce, B., Dale, B., Mackey, D., & McNichol, L. (2014). Wound, Ostomy and Continence Nurses Society's Guidance on OASIS-C1 Integumentary Items: Best Practice for Clinicians. Adapted from: http://c.ymcdn.com/sites/www.wocn.org/resource/resmgr/ Publications/WOCN_Guidance_on_OASIS-C1_In.pdf NPUAP Pressure Ulcer Category/Staging Illustrations. Illustrations used with permission of the National Pressure Ulcer Advisory Panel, 2015.09.14. © NPUAP.

the patient at home to prevent pressure ulcers. Shifting weight allows the blood to flow into the ischemic areas and helps tissues recover from the effects of pressure. Attention should be paid to patient migration (moving down in the bed) in those on bed rest, particularly when the head of the bed is elevated (Wiggermann, Kotowski, Davis, et al., 2015).

For patients who spend long periods in a wheelchair, pressure can be relieved by:

- *Push-ups*: The patient pushes down on armrests and raises buttocks off the seat of the chair (see Fig. 51-11).
- *One half push-up*: The patient repeats the push-up on the right side and then the left, pushing up on one side by pushing down on the armrest.
- *Moving side to side*: The patient moves from one side to the other while sitting in the chair.
- *Shifting*: The patient bends forward with the head down between the knees (if able) and constantly shifts in the chair.

Positioning the Patient

The degree of ability to move independently—the comfort, fatigue, loss of sensation, overall physical and mental status, and specific disorder—influences plans for changing position. Patients should be positioned laterally, prone, and dorsally in sequence unless a position is not tolerated or is contraindicated. Generally, those who experience discomfort after 30 to 60 minutes of lying prone need to be repositioned. The recumbent position is preferred to the semi-Fowler position because of increased supporting body surface area in this position.

Patients able to shift their weight every 15 to 20 minutes and move independently may change total position every 2 to 4 hours. Indications for routine repositioning every 2 hours or more frequently include loss of sensation, paralysis, coma, and edema.



Figure 51-11 • Wheelchair push-up to prevent ischial pressure ulcers. These push-ups should become an automatic routine (every 15 minutes) for the person with paraplegia. The person should stay up and out of contact with the seat for several seconds. The wheels are kept in the locked position during the exercise.

In addition to regular turning, small shifts of body weight, such as repositioning of an ankle, elbow, or shoulder, are necessary. The skin is inspected at each position change and assessed for temperature elevation. If redness or heat is noted or if the patient complains of discomfort, pressure on the area must be relieved.

Another way to relieve pressure over bony prominences is the bridging technique, accomplished through the correct positioning of pillows. Just as a bridge is supported on pillars to allow traffic to move underneath, the body can be supported by pillows to allow for space between bony prominences and the mattress. A pillow or commercial heel protector may be used to support the heels off the bed when the patient is supine. Placing pillows superior and inferior to the sacrum relieves sacral pressure. Supporting the patient in a 30-degree side-lying position avoids pressure on the trochanter. In older adult patients, frequent small shifts of body weight may be effective. Placing a small rolled towel or sheepskin under a shoulder or hip allows a return of blood flow to the skin in the area on which the patient is sitting or lying. The towel or sheepskin is moved around the patient's pressure points in a clockwise fashion. A turning schedule can help the family keep track of the patient's turns.

Using Pressure-Relieving Devices

At times, specialty beds or alternative bed surfaces may be indicated to help relieve the pressure on the skin (Stifter, Yao, Lodhi, et al., 2015). This is particularly important for patients who cannot get out of bed and who are at high risk for pressure ulcer development. These devices are designed to provide support for specific body areas or to distribute pressure evenly.

A patient who sits in a wheelchair for prolonged periods should have wheelchair cushions fitted and adjusted on an individualized basis, using pressure measurement techniques as a guide to selection and fitting. The aim is to redistribute pressure away from areas at risk for ulcers; however, no cushion can eliminate excessive pressure completely. The patient should be reminded to shift weight frequently and to rise for a few seconds every 15 minutes while sitting in a chair.

Static support devices (e.g., high-density foam, air, or liquid mattress overlays) distribute pressure evenly by bringing more of the patient's body surface into contact with the supporting surface. Gel-type flotation pads and air-fluidized beds reduce pressure. The weight of a body floating on a fluid system is evenly distributed over the entire supporting surface. Therefore, as the body sinks into the fluid, additional surface becomes available for weight bearing, body weight per unit area is decreased, and there is less pressure on the body parts.

Soft, moisture-absorbing padding is also useful because the softness and resilience of padding provide for more even distribution of pressure and the dissipation and absorption of moisture, along with freedom from wrinkles and friction. Bony prominences may be protected by gel pads, sheepskin padding, or soft foam rubber beneath the sacrum, the trochanters, heels, elbows, scapulae, and back of the head when there is pressure on these sites. One group of researchers found that sacral pressure was reduced using a liquid-based pad that covers only the sacral area and can be applied on any bed surface (Duetzmann, Forsey, Senft, et al., 2015).

Specialized beds are designed to prevent pressure on the skin. Air-fluidized beds allow the patient to float. Dynamic support surfaces, such as low air-loss pockets, alternately

inflate and deflate sections to change support pressure for very high risk patients who are critically ill and debilitated (i.e., impaired strength, weakened, injured, disabled) and cannot be repositioned to relieve pressure. Oscillating or kinetic beds change pressure by means of rocking movements of the bed that redistribute the patient's weight and stimulate circulation. These beds may be used with patients who have injuries attributed to multiple trauma. Specialized beds, which are more expensive than mattress overlays, are no more effective at preventing pressure ulcers than the overlays; there is insufficient evidence to support the choice of one specific bed surface over another (Qaseem, Humphrey, Forciea, et al., 2015).

Improving Mobility

The patient is encouraged to remain active and is ambulated whenever possible. When sitting, the patient is reminded to change positions frequently to redistribute weight. Active and passive exercises increase muscular, skin, and vascular tone. For patients at risk for pressure ulcers, turning and exercise schedules are essential, and repositioning must occur around the clock.

Improving Sensory Perception

The nurse helps the patient recognize and compensate for altered sensory perception. Depending on the origin of the alteration (e.g., decreased level of consciousness, spinal cord lesion), specific interventions are selected. Strategies to improve cognition and sensory perception may include stimulating the patient to increase awareness of self in the environment, encouraging the patient to participate in self-care, or supporting the patient's efforts toward active compensation for loss of sensation (e.g., a patient with paraplegia lifting up from the sitting position every 15 minutes). A patient with quadriplegia should be weight shifted every 30 minutes while sitting in a wheelchair. When decreased sensory perception exists, the patient and caregivers are taught to inspect potential pressure areas visually every morning and evening, using a mirror if necessary, for evidence of pressure ulcer development.

Improving Tissue Perfusion

Activity, exercise, and repositioning improve tissue perfusion. Massage of erythematous areas is avoided because damage to the capillaries and deep tissue may occur (National Pressure Ulcer Advisory Panel, 2014).

Nursing Alert: The nurse should avoid massaging reddened areas because this may increase the damage to already traumatized skin and tissue.

In patients who have evidence of compromised peripheral circulation (e.g., edema), positioning and elevation of the edematous body part to promote venous return and diminish congestion improve tissue perfusion. In addition, the nurse or family must be alert to environmental factors (e.g., wrinkles in sheets, pressure of tubes) that may contribute to pressure on the skin and diminished circulation and remove the source of pressure.

Improving Nutritional Status

The patient's nutritional status must be adequate, and a positive nitrogen balance must be maintained because pressure ulcers develop more quickly and are more resistant to treatment in patients with nutritional disorders. A high-protein diet with protein supplements may be helpful. Iron preparations may be necessary to raise the hemoglobin concentration so that tissue oxygen levels can be maintained within acceptable limits. Ascorbic acid (vitamin C) is necessary for tissue healing. Other nutrients associated with healthy skin include vitamin A, B vitamins, zinc, and sulfur. With adequate nutrition and hydration, the skin can remain healthy, and damaged tissues can be repaired (Posthauer, Banks, Dorner, et al., 2015); (Saha, Smith, Totten, et al., 2013).

To assess the patient's nutritional status in response to therapeutic strategies, the nurse monitors the patient's hemoglobin, pre-albumin level, and body weight weekly. Nutritional assessment is described in further detail in Chapter 3.

Reducing Friction and Shear

Raising the head of the bed by even a few centimeters increases the shearing force over the sacral area; therefore, the semi-reclining position is avoided in patients at risk. Proper positioning with adequate support is also important when the patient is sitting in a chair.

Nursing Alert: To avoid shearing forces when repositioning patients, the nurse must lift and avoid dragging patients across a surface. Lift devices should be used to prevent occupational injuries.

Minimizing Irritating Moisture

Continuous moisture on the skin must be prevented by meticulous hygiene measures. It is important to pay special attention to skin folds, including areas under the breasts, arms, and groin, and between the toes. Perspiration, urine, stool, and drainage must be removed from the skin promptly. The soiled skin should be washed immediately with mild soap and water and blotted dry with a soft towel. The skin may be lubricated with a bland lotion to keep it soft and pliable. Drying agents and powders are avoided. Topical barrier ointments (e.g., petroleum jelly) may be helpful in protecting the skin of patients who are incontinent.

Absorbent pads that wick moisture away from the body should be used to absorb drainage. Patients who are incontinent need to be checked regularly and have their wet incontinence pads and linens changed promptly. Their skin needs to be cleansed and dried promptly.

Promoting Pressure Ulcer Healing

Regardless of the stage of the pressure ulcer, the pressure on the area must be eliminated because the ulcer will not heal until all pressure is removed. The patient must not lie or sit on the pressure ulcer, even for a few minutes. Individualized positioning and turning schedules must be written in the plan of nursing care and followed meticulously.

In addition, inadequate nutritional status and fluid and electrolyte abnormalities must be corrected to promote healing. Wounds from which body fluids and protein drain place the patient in a catabolic state and predispose to hypoproteinemia and serious secondary infections. Protein deficiency must be corrected to promote the healing of the pressure ulcer. Carbohydrates are necessary to "spare" the protein and to provide an energy source. Vitamin C and trace elements, especially zinc, are necessary for collagen formation and wound healing. (Refer to Chart 51-10 for descriptions of stages of pressure ulcers.)

Deep Tissue Injury. These tissue injuries may evolve rapidly, and immediate pressure relief to the affected area is indicated.

Therefore, the nurse must be vigilant in assessing for these types of injuries (Dunk & Carville, 2015); (National Pressure Ulcer Advisory Panel, 2014).

Stage I Pressure Ulcers. To permit healing of stage I pressure ulcers, the pressure is removed to allow increased tissue perfusion, nutritional and fluid and electrolyte balance is maintained, friction and shear are reduced, and moisture to the skin is avoided (Dunk & Carville, 2015); (National Pressure Ulcer Advisory Panel, 2014).

Stage II Pressure Ulcers. In addition to measures listed for stage I pressure ulcers, a moist environment, in which migration of epidermal cells over the ulcer surface occurs more rapidly, should be provided to aid wound healing. The ulcer is gently cleansed with sterile saline solution. The use of a heat lamp to dry the open wound is avoided, as is the use of antiseptic solutions that damage healthy tissues and delay wound healing. Semipermeable occlusive dressings, hydrocolloid wafers, or wet saline dressings are helpful in providing a moist environment for healing and in minimizing the loss of fluids and proteins from the body (Dunk & Carville, 2015); (National Pressure Ulcer Advisory Panel, 2014).

Stage III Pressure Ulcers. Stage III pressure ulcers are characterized by extensive tissue damage, including slough (i.e., soft, moist avascular tissue), tunneling (i.e., formation of a sinus tract), and undermining (i.e., extensive tunneling under wound edge), to name a few. Given the extensive damage to tissue and necrosis that characterize stage III pressure ulcers, they must be cleaned (débrided) to create an area that will heal, in addition to the measures listed for stage I pressure ulcers. Necrotic, devitalized tissue favors bacterial growth, delays granulation, and inhibits healing. Wound cleaning and dressing are uncomfortable; therefore, the nurse must prepare the patient for the procedure by explaining what will occur and administering prescribed analgesia (Dunk & Carville, 2015); (National Pressure Ulcer Advisory Panel, 2014).

Stage IV Pressure Ulcers. Surgical interventions are required for these extensive pressure ulcers (National Pressure Ulcer Advisory Panel, 2014). (See the following Other Treatment Methods section.)

Other Treatment Methods

Débridement may be accomplished by wet-to-damp dressing changes, mechanical flushing of necrotic and infective exudate, application of prescribed enzyme preparations that dissolve necrotic tissue, or surgical dissection. If eschar (dry scab) covers the ulcer, it is removed surgically to ensure the wound is clean and vitalized. Exudate may be absorbed by dressings or special hydrophilic powders, beads, or gels. Cultures of infected pressure ulcers are obtained to guide the selection of antibiotic therapy.

After the pressure ulcer is clean, a topical treatment is prescribed to promote granulation. New granulation tissue must be protected from reinfection, drying, and damage, and care should be taken to prevent pressure and further trauma to the area. Dressings, solutions, and ointments applied to the ulcer should not disrupt the healing process. For chronic, noninfected ulcers that are healing by secondary intention (healing of an open wound from the base upward by laying down new tissue), vacuum-assisted closure (VAC) or hyperbaric oxygen treatment may be used. VAC involves the use of a negative-pressure sponge dressing in the wound to increase blood flow, increasing formation of granulation tissue and nutrient uptake and decreasing bacterial load. Hyperbaric oxygen therapy involves either the application of topical oxygen at increased pressure directly to the wound or placing the patient into a hyperbaric oxygen chamber. Both methods of hyperbaric oxygen therapy promote wound healing by stimulating new vascular growth and aiding in the preservation of damaged tissue (Dauwe, Pulikkottil, Lavery, et al., 2014). In a recent systematic review, Stoekenbroek, Santema, Legemate, et al. (2014) reported that hyperbaric oxygen therapy improves healing in patients with diabetic leg ulcers; however, more studies are needed prior to routinely introducing this therapy into clinical practice.

Multiple agents and protocols are used to treat pressure ulcers; however, consistency is an important key to success. Objective evaluation of the pressure ulcer (e.g., measurement of the size and depth of the pressure ulcer, inspection for granulation tissue) for response to the treatment protocol must be made every 4 to 6 days. Taking photographs at weekly intervals is a reliable strategy for monitoring the healing process, which may take weeks to months.

Surgical intervention is necessary when the ulcer is extensive, when complications (e.g., fistula) exist, and when the ulcer does not respond to treatment. Surgical procedures include débridement, incision and drainage, bone resection, and skin grafting. Osteomyelitis is a common complication of wounds of stage IV depth. (See Chapter 37 for more information on osteomyelitis.)

Preventing Recurrence

It may take more than a year for healing tissue to regain the strength of pre-injury skin; thus, care must be taken to prevent recurrence of pressure ulcers. However, recurrence of pressure ulcers should be anticipated; therefore, active, preventive intervention and frequent continuing assessments are essential. For example, pressure ulcers are the second most comorbid problem in patients with SCI with 85% of patients with SCI developing a pressure ulcer at least once in their lifetime (Scheel-Sailer, Wyss, Boldt, et al., 2013). The patient's tolerance for sitting or lying on the healed pressure area is increased gradually by increasing the time that pressure is allowed on the area in 5-to 15-minute increments. The patient is instructed to increase mobility and to follow a regimen of turning, weight shifting, and repositioning. The patient education plan includes strategies to reduce the risk of pressure ulcers and methods to detect, inspect, and minimize pressure areas. Early recognition and intervention are keys to long-term management of potential impaired skin integrity. Gould, Olney, Nichols, et al. (2014) suggest immobility and incontinence are among modifiable risk factors that contribute to recurrent pressure ulcer development, particularly in patients with SCI; they suggest the development of structured guidelines to prevent pressure ulcers rests on the identification of factors that differ in patients with SCI who have none, one, or more pressure ulcers. Identifying potentially modifiable risk factors or protective factors may then lead to evidence-based risk assessment tools and interventions customized to patient-specific risks.

Evaluation

Expected patient outcomes may include:

1. Maintains intact skin
   a. Exhibits no areas of nonblanchable erythema at bony prominences
   b. Avoids massage of bony prominences

   c. Exhibits no breaks in skin
2. Limits pressure on bony prominences
   a. Changes position every 1 to 2 hours
   b. Uses bridging techniques to reduce pressure
   c. Uses special equipment as appropriate
   d. Raises self from seat of wheelchair every 15 minutes
3. Increases mobility
   a. Performs range-of-motion exercises
   b. Adheres to turning schedule
   c. Advances sitting time as tolerated
4. Has improved sensory and cognitive ability
   a. Demonstrates improved level of consciousness
   b. Remembers to inspect potential pressure ulcer areas every morning and evening
5. Demonstrates improved tissue perfusion
   a. Exercises to increase circulation
   b. Elevates body parts susceptible to edema
6. Attains and maintains adequate nutritional status
   a. Verbalizes the importance of protein and vitamin C in diet
   b. Eats diet high in protein and vitamin C
   c. Exhibits acceptable levels of hemoglobin, electrolyte, prealbumin, transferrin, and creatinine
7. Avoids friction and shear
   a. Avoids semireclining position
   b. Uses heel protectors when appropriate
   c. Lifts body instead of sliding across surfaces
8. Maintains clean, dry skin
   a. Avoids prolonged contact with wet or soiled surfaces
   b. Keeps skin clean and dry
   c. Uses lotion to keep skin lubricated

NURSING PROCESS

The Patient With Altered Elimination Patterns

Urinary incontinence and bowel incontinence or constipation and impaction are problems that often occur in patients with disabilities. Incontinence curtails the person's independence, causing embarrassment and isolation. Based on structured oral interviews conducted to collect data on bothersome urinary or fecal incontinence in adults aged 50 and older, 20% of women and 6.4% of men reported urinary incontinence (less than once/month, a few times/month, a few times/week or every day/night) (Gorina, Schappert, Bercovitz, et al., 2014); (Roe, Flanagan, & Maden, 2015). Fecal incontinence (leakage of gas, mucus, liquid or solid stool at least monthly) was reported by 8.2% of women and 8.4% of men (Wu, Matthews, Vaughan, et al., 2015). Internationally, nearly 55% of nursing home residents will experience bowel and/or bladder incontinence at some point (Mandl, Halfens, & Lohrmann, 2015). For patients with disabilities who experience constipation, complete and predictable evacuation of the bowel is the goal. If a bowel routine is not established, the patient may experience abdominal distention; small, frequent oozing of stool; or impaction.

Assessment

Urinary incontinence may result from multiple causes, including urinary tract infection, detrusor instability, bladder outlet obstruction or incompetence, neurologic impairment, bladder spasm or contracture, and inability to reach the toilet in time. Urinary incontinence can be classified as urge, reflex, stress, functional, overflow, or total (Herdman & Kamitsuru, 2014):

- *Urge incontinence* occurs when involuntary elimination of urine is associated with a strong perceived need to void.
- *Reflex (neurogenic) incontinence* is associated with a spinal cord lesion that interrupts cerebral control, resulting in no sensory awareness of the need to void.
- *Stress incontinence* is associated with weakened perineal muscles that permit leakage of urine when intra-abdominal pressure is increased (e.g., with coughing or sneezing).
- *Functional incontinence* occurs in patients with intact urinary physiology who experience mobility impairment, environmental barriers, or cognitive problems and cannot reach and use the toilet before soiling themselves.
- *Overflow urinary incontinence* is described as the involuntary loss of urine associated with overdistention of the bladder. Reasons for overdistention and urine leakage vary, but may be related to improper emptying of the bladder, fecal impaction, urethral obstruction, or medication side effect.
- *Total urinary incontinence* occurs in patients who cannot control urine because of physiologic or psychological impairment. Management of the urine is an essential focus of nursing care.

Elimination Assessment

The health history is used to explore bladder and bowel function, symptoms associated with dysfunction, physiologic risk factors for elimination problems, perception of micturition (urination, or voiding), and functional toileting abilities. Previous and current fluid intake and voiding patterns may be helpful in designing the plan of nursing care. A record of times of voiding and amounts voided is kept for at least 48 hours. In addition, episodes of incontinence and associated activity (e.g., coughing, sneezing, lifting), fluid intake time and amount, and medications are recorded. This record is analyzed and used to determine patterns and relationships of incontinence to other activities and factors.

The ability to get to the bathroom, manipulate clothing, and use the toilet are important functional factors that may be related to incontinence. Related cognitive functioning (perception of need to void, verbalization of need to void, and ability to learn to control urination) must also be assessed. In addition, the nurse reviews the results of the diagnostic studies (e.g., urinalysis, urodynamic tests, post-voiding residual volumes).

Bowel incontinence and constipation may result from multiple causes, such as diminished or absent sphincter control, cognitive or perceptual impairment, neurogenic factors, diet, and immobility. The origin of the bowel problem must be determined. The nurse assesses the patient's normal bowel patterns, nutritional patterns, use of laxatives, gastrointestinal problems (e.g., colitis), bowel sounds, anal reflex and tone, and functional abilities. The character and frequency of bowel movements are recorded and analyzed.

Nursing Diagnosis

Based on the assessment data, major nursing diagnoses may include the following:

- Functional urinary incontinence
- Urge urinary incontinence

- Reflex urinary incontinence
- Stress urinary incontinence
- Impaired urinary elimination
- Overflow urinary incontinence
- Urinary retention
- Constipation
- Bowel incontinence

Planning and Goals

The major goals may include control of urinary incontinence or urinary retention, control of bowel incontinence, and regular elimination patterns.

Nursing Interventions

Promoting Urinary Continence

After the nature of the urinary incontinence has been identified, a plan of nursing care is developed based on an analysis of the assessment data. Various approaches to promote urinary continence have been developed (Roe, Flanagan, & Maden, 2015). Most approaches attempt to condition the body to control urination or to minimize the occurrence of unscheduled urination. Selection of the approach depends on the cause and type of the incontinence. For the program to be successful, participation by the patient and a desire to avoid incontinence episodes are crucial; an optimistic attitude with positive feedback for even slight gains is essential for success. Accurate recording of intake and output and of the patient's response to selected strategies is essential for evaluation.

At no time should the fluid intake be restricted to decrease the frequency of urination. Sufficient fluid intake (2,000 to 3,000 mL per day, according to patient needs) must be ensured. To optimize the likelihood of voiding as scheduled, measured amounts of fluids may be given about 30 minutes before voiding attempts. In addition, most of the fluids should be consumed before evening to minimize the need to void frequently during the night.

Nursing Alert: Carbonated soft drinks, milk shakes, alcohol, tomato juice, and citrus fruit juices are alkaline-producing drinks that promote bacterial growth in the urine. Patients should be encouraged to drink more acid-producing fluids (e.g., cranberry and cranapple juice) to reduce the chance of urinary tract infection. Water is a preferred fluid because it flushes the kidneys and bladder.

The goal of bladder training is to restore the bladder to normal function. Bladder training can be used with cognitively intact patients experiencing urge incontinence. A voiding and toileting schedule is developed based on an analysis of the assessment data. The schedule specifies times for the patient to try to empty the bladder using a bedpan, toilet, or commode. Privacy should be provided during voiding efforts. The interval between voiding times in the early phase of the bladder training period is short (90 to 120 minutes). The patient is encouraged not to void until the specified voiding time. Voiding success and episodes of incontinence are recorded. As the patient's bladder capacity and control increase, the interval is lengthened. Usually, there is a temporal relationship between drinking, eating, exercising, and voiding. Alert patients can participate in recording intake, activity, and voiding and can plan the schedule to achieve maximum continence. Barrier-free access to the toilet and modification of clothing can help patients with functional incontinence achieve self-care in toileting and continence.

Habit training is used to try to keep patients dry by strict adherence to a toileting schedule and may be successful with stress, urge, or functional incontinence. If the patient is confused, caregivers take the patient to the toilet according to the schedule before involuntary voiding occurs. Simple cuing and consistency promote success. Periods of continence and successful voiding are positively reinforced.

Biofeedback is a system through which patients learn to consciously contract urinary sphincters and control voiding cues. Cognitively intact patients who have stress or urge incontinence may gain bladder control through biofeedback.

Pelvic floor exercises (Kegel exercises) strengthen the pubococcygeus muscle. The patient is instructed to tighten the pelvic floor muscles for 4 seconds 10 times, and this is repeated 4 to 6 times a day. Stopping and starting the stream during urination is recommended to increase control. Daily practice is essential. These exercises are helpful for cognitively intact women who experience stress incontinence.

Suprapubic tapping or stroking of the inner thigh may produce voiding by stimulating the voiding reflex arc in patients with reflex incontinence. However, this method is not always effective, owing to a lack of detrusor sphincter muscle coordination. As the bladder reflexively contracts to expel urine, the bladder sphincter reflexively closes, producing a high residual urine volume and an increased incidence of urinary tract infection.

Intermittent self-catheterization is an appropriate alternative for managing reflex incontinence, urinary retention, and overflow incontinence attributed to an overdistended bladder. The nurse emphasizes regular emptying of the bladder rather than sterility. Patients with disabilities may reuse and clean catheters with bleach or hydrogen peroxide solutions or soap and water and may use a microwave oven to sterilize catheters. Aseptic intermittent catheterization technique is required in health care institutions because of the potential for bladder infection from resistant organisms. Intermittent self-catheterization may be difficult for patients with limited mobility, dexterity, or vision; however, family members can be taught the procedure.

Self-catheterization is also particularly pertinent for patients with SCI, because most of these patients do not have voluntary control of urination. Even those patients with spinal cord injuries who can voluntarily void should measure their residual urine (the amount of urine that remains in the bladder after voluntary or involuntary voiding) by self-catheterization.

Indwelling catheters are avoided if at all possible because of the high incidence of urinary tract infections associated with their use. Short-term use may be needed during treatment of severe skin breakdown due to continued incontinence. Patients with disabilities who cannot perform intermittent self-catheterization may elect to use suprapubic catheters for long-term bladder management. Suprapubic catheters are easier to maintain than indwelling catheters.

External catheters (condom catheters) and leg bags to collect spontaneous voidings are useful for male patients with reflex or total incontinence. The appropriate design and size must be chosen for maximal success, and the patient or caregiver must be taught how to apply the condom catheter and how to provide daily hygiene, including skin inspection. Instruction on emptying the leg bag must also be provided, and modifications can be made for patients with limited hand dexterity.

Incontinence pads (briefs) may be useful at times for patients with stress or total incontinence to protect clothing

but should be avoided whenever possible. Incontinence pads only manage, rather than solve, the incontinence problem. In addition, they have a negative psychological effect on patients, because many people think of the pads as diapers. Every effort should be made to reduce the incidence of incontinence episodes through the other methods that have been described. When incontinence pads are used, they should wick moisture away from the body to minimize contact of moisture and excreta with the skin. Wet incontinence pads must be changed promptly, the skin cleansed, and a moisture barrier applied to protect the skin. It is important for the patient's self-esteem to avoid use of the term *diapers*.

Promoting Bowel Continence

The goals of a bowel training program are to develop regular bowel habits and to prevent uninhibited bowel elimination. Regular, complete emptying of the lower bowel results in bowel continence. A bowel training program takes advantage of the patient's natural reflexes. Regularity, timing, nutrition and fluids, exercise, as well as correct positioning promote predictable defecation (Hotouras, Ribas, Allison, et al., 2014).

The nurse records defecation time, character of stool, nutritional intake, cognitive abilities, and functional self-care toileting abilities for 5 to 7 days. Analysis of this record is helpful when designing a bowel program for patients with fecal incontinence.

Consistency in implementing the plan is essential. A regular time for defecation is established, and attempts at evacuation should be made within 15 minutes of the designated time daily. Natural gastrocolic and duodenocolic reflexes occur about 30 minutes after a meal; therefore, after breakfast is one of the best times to plan for bowel evacuation. However, if the patient had a previously established habit pattern at a different time of day, it should be followed.

The anorectal reflex may be stimulated by a rectal suppository (e.g., glycerin) or by mechanical stimulation (e.g., digital stimulation with a lubricated gloved finger or anal dilator). Mechanical stimulation should be used only in patients with a disability who have no voluntary motor function and no sensation as a result of injuries above the sacral segments of the spinal cord, such as patients with quadriplegia, high paraplegia, or severe brain injuries. The technique is not effective in patients who do not have an intact sacral reflex arc (e.g., those with flaccid paralysis). Mechanical stimulation, suppository insertion, or both should be initiated about 30 minutes before the scheduled bowel elimination time, and the interval between stimulation and defecation is noted for subsequent modification of the bowel program. Once the bowel routine is well established, stimulation with a suppository may not be necessary.

The patient should assume the normal squatting position and be in a private bathroom for defecation if at all possible, although a padded commode chair or bedside toilet is an alternative. An elevated toilet seat is a simple modification that may make use of the toilet easier for the patient with a disability. Seating time is limited in patients who are at risk for skin breakdown. Bedpans should be avoided. A patient with a disability who cannot sit on a toilet should be positioned on the left side with legs flexed and the head of the bed elevated 30 to 45 degrees to increase intra-abdominal pressure. Protective padding is placed behind the buttocks. When possible, the patient is instructed to bear down and to contract the abdominal muscles. Massaging the abdomen from right to left facilitates movement of feces in the lower tract.

Preventing Constipation

The record of bowel elimination, character of stool, food and fluid intake, level of activity, bowel sounds, medications, and other assessment data are reviewed to develop the plan of care. Multiple approaches may be used to prevent constipation. The diet should include adequate intake of high-fiber foods (vegetables, fruits, bran) to prevent hard stools and to stimulate peristalsis. Daily fluid intake should be 2 to 3 L unless contraindicated. Drinking prune juice (120 mL) 30 minutes before a meal once daily is helpful in some cases when constipation is a problem. Physical activity and exercise are encouraged, as is self-care in toileting. Patients are encouraged to respond to the natural urge to defecate. Privacy during toileting is provided. Stool softeners, bulk-forming agents, mild stimulants, and suppositories may be prescribed to stimulate defecation and to prevent constipation.

Evaluation

Expected patient outcomes may include:

1. Demonstrates control of bowel and bladder function
   a. Experiences no episodes of incontinence
   b. Avoids constipation
   c. Achieves independence in toileting
   d. Expresses satisfaction with level of bowel and bladder control
2. Achieves urinary continence
   a. Uses therapeutic approach that is appropriate to type of incontinence
   b. Maintains adequate fluid intake
   c. Washes and dries skin after episodes of incontinence
3. Achieves bowel continence
   a. Participates in bowel program
   b. Verbalizes need for regular time for bowel evacuation
   c. Modifies diet to promote continence
   d. Uses bowel stimulants as prescribed and needed
4. Experiences relief of constipation
   a. Uses high-fiber diet, fluids, and exercise to promote defecation
   b. Responds to urge to defecate

Promoting Home, Community-Based, and Transitional Care

An important goal of rehabilitation is to assist the patient to return to the home environment after learning to manage the disability. A referral system maintains continuity of care when the patient is transferred to the home or to a long-term care facility. The plan for discharge is formulated when the patient is first admitted to the hospital, and discharge plans are made with the patient's functional potential in mind.

Educating Patients About Self-Care

Significant expenditures of time and resources are necessary to ensure that patients gain the skills and confidence to self-manage their health effectively after discharge from the hospital (Schmidt, 2013). Formal programs provide patients with effective strategies for interpreting and managing disease-specific issues and skills needed for problem solving, as well as building and maintaining self-awareness and self-efficacy. Self-care programs often use multifaceted approaches, including didactic teaching,

group sessions, individual learning plans, and Web-based resources. When planning the approach to self-care, the nurse must consider the individual patient's knowledge, experience, social and cultural background, level of formal education, and psychological status. The preparation for self-care must also be spread out over the course of the recovery period, and it must be monitored and updated regularly as the patient masters aspects of self-care. Preparation for self-care is also highly relevant for informal caregivers of patients in rehabilitation.

When a patient is discharged from acute care or a rehabilitation facility, informal caregivers, typically family members, often assume the care and support of the patient. Although the most obvious care tasks involve physical care (e.g., personal hygiene, dressing, meal preparation), other elements of the caregiving role include psychosocial support and a commitment to this supportive role. Thus, the nurse must assess the patient's support system (family, friends) well in advance of discharge. The positive attitudes of family and friends toward the patient, their disability, and the return home are important in making a successful transition to home. Not all families can carry out the arduous programs of exercise, physical therapy, and personal care that the patient may need. They may not have the resources or stability to care for family members with a severe disability. The physical, emotional, economic, and energy strains of a disabling condition may overwhelm even a stable family. Members of the rehabilitation team must not judge the family but rather should provide supportive interventions that help the family to attain its highest level of function.

The family members need to know as much as possible about the patient's condition and care so that they do not fear the patient's return home. The nurse develops methods to help the patient and family cope with problems that may arise. For example, the nurse may develop an ADL checklist individualized for the patient and family to ensure that the family is proficient in assisting the patient with certain tasks (see Chart 51-11).

Chart 51-11 HOME CARE CHECKLIST

Managing the Therapeutic Regimen at Home

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of disability on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State changes in lifestyle (e.g., diet, activity) necessary to maintain health.
- State the name, dose, side effects, frequency, and schedule for all medications.
- State how to obtain medical supplies after discharge.
- Identify durable medical equipment needs, proper usage, and maintenance necessary for safe utilization:
  - Wheelchair—manual/power
  - Cushion
  - Grab bars
  - Sliding board
  - Mechanical lift
  - Raised padded commode seat
  - Padded commode wheelchair
  - Bedside commode
  - Crutches
  - Walker
  - Cane
  - Prosthesis
  - Orthosis
  - Shower chair
  - Specialty bed
- Demonstrate usage of adaptive equipment for activities of daily living:
  - Long-handled sponge
  - Reacher
  - Universal cuff
  - Plate mat and guard
  - Rocker-knife, spork, weighted utensils
  - Special closures for clothing
  - Other
- Demonstrate mobility skills:
  - Transfers: bed to chair; in and out of toilet and tub; in and out of car
  - Negotiate ramps, curbs, stairs
  - Assume sitting from supine position
  - Turn side to side in bed
  - Maneuver wheelchair; manage armrests and leg rests; lock brakes
  - Ambulate safely using assistive devices
  - Perform range-of-motion exercises
  - Perform muscle-strengthening exercises
- Demonstrate skin care:
  - Inspect bony prominences every morning and evening
  - Identify stage I pressure ulcer and actions to take if present
  - Change dressings for stage II to IV pressure ulcers
  - State dietary requirements to promote healing of pressure ulcers
  - Demonstrate pressure relief at prescribed intervals
  - State sitting schedule and demonstrate weight lifts in wheelchair
  - Demonstrate adherence to bed turning schedule, bed positioning, and the use of bridging techniques
  - Apply and wear protective boots at prescribed times
  - Demonstrate correct wheelchair sitting posture
  - Demonstrate techniques to avoid friction and shear in bed
  - Demonstrate proper hygiene to maintain skin integrity
- Demonstrate bladder care:
  - State schedule for voiding, toileting, and catheterization
  - Identify relationship of fluid intake to voiding and catheterization schedule
  - State how to perform pelvic floor exercises
  - Demonstrate clean self-intermittent catheterization and care of catheterization equipment
  - Demonstrate indwelling catheter care
  - Demonstrate application of external condom catheter
  - Demonstrate application, emptying, and cleaning of urinary drainage bag
  - Demonstrate application of incontinence pads and performance of perineal hygiene
  - State signs and symptoms of urinary tract infection
  - State signs and symptoms of urinary catheter blockage
- Demonstrate bowel care:
  - State optimum dietary intake to promote evacuation
  - Identify schedule for optimum bowel evacuation
  - Demonstrate techniques to increase intra-abdominal pressure: Valsalva maneuver; abdominal massage; leaning forward
  - Demonstrate techniques to stimulate bowel movements: ingesting warm liquids; digital stimulation; insertion of suppositories

(*Continued*)

(*Continued*)

- Demonstrate optimum position for bowel evacuation: on toilet with knees higher than hips; left side in bed with knees flexed and head of bed elevated 30 to 45 degrees
- Identify complications and corrective strategies for bowel retraining: constipation, impaction, diarrhea, hemorrhoids, rectal bleeding, anal tears

• Identify community resources for peer and caregiver/family support:
- Identify sources of support (e.g., friends, relatives, faith community)
- Identify phone numbers of support groups for people with disabilities and their caregivers/families
- State meeting locations and times

• Demonstrate how to access transportation:
- Identify locations of wheelchair accessibility for public buses or trains
- Identify phone numbers for private wheelchair van
- Contact Division of Motor Vehicles for handicapped parking permit
- Contact Division of Motor Vehicles for driving test when appropriate
- Identify resources for adapting private vehicle with hand controls or wheelchair lift

• Identify vocational rehabilitation resources:
- State name and phone number of vocational rehabilitation counselor
- Identify educational opportunities that may lead to future employment

• Identify community resources for recreation:
- State local recreation centers that offer programs for people with disabilities
- Identify leisure activities that can be pursued in the community
- State how to reach primary provider with questions or if complications arise
- State time and date of follow-up appointments
- Identify the need for health promotion, disease prevention, and screening activities

ADLs, activities of daily living; IADLs, instrumental activities of daily living.

Continuing and Transitional Care

A home care or transitional care nurse may visit the patient prior to discharge, interview the patient and the family, and review the ADL sheet to learn which activities the patient can perform. This helps to ensure that continuity of care is provided and that the patient does not regress yet maintains the independence gained while in the hospital or rehabilitation setting. The family may need to purchase, borrow, or improvise needed equipment, such as safety rails, a raised toilet seat or commode, or a tub bench. Ramps may need to be built or doorways widened to allow full access.

Family members are taught how to use equipment and are given a copy of the equipment manufacturer's instruction booklet, the names of resource people, lists of equipment-related supplies, and locations where they may be obtained. A written summary of the care plan is included in family education. The patient and family members are reminded about the importance of routine health screening and other health promotion strategies.

A network of support services and communication systems may be required to enhance opportunities for independent living. The nurse uses collaborative, administrative skills to coordinate these activities and pull together the network of care. The nurse also provides skilled care, initiates additional referrals when indicated, and serves as a patient advocate and counselor when obstacles are encountered. The nurse continues to reinforce prior patient education and helps the patient to set and achieve attainable goals. The degree to which the patient adapts to the home and community environment depends on the confidence and self-esteem developed during the rehabilitation process and on the acceptance, support, and reactions of family members, employers, and community members.

There is a growing trend toward independent living by people with severe disabilities, either alone or in groups that share resources. Preparation for independent living should include training in managing a household and working with personal care attendants as well as training in mobility. The goal is integration into the community—living and working in the community with accessible housing, employment, public buildings, transportation, and recreation.

State rehabilitation administration agencies provide services to assist people with disabilities in obtaining the help they need to engage in gainful employment. These services include diagnostic, medical, and mental health services. Counseling, training, placement, and follow-up services are available to help people with disabilities select and obtain jobs.

If the patient is transferred to a long-term care facility, the transition is planned to promote continued progress. Independence gained continues to be supported, and progress is fostered. Adjustment to the facility is promoted through communication. Family members are encouraged to visit, to be involved, and to take the patient home on weekends and holidays if possible.

CRITICAL THINKING EXERCISES

1. An 18-year-old man is brought to the ED by his family, who report that he was "dinged" in a football game 1 week ago. The patient does not recall the event. His family states that he is sleeping more than usual and seems forgetful. What is the evidence base for conducting a comprehensive and focused evaluation for a patient with a sports concussion injury? What evidence-based recommendations may guide return to sports for this patient? Identify the criteria used to evaluate the strength of the evidence for these practices.
2. A 90-year-old patient on anticoagulant therapy is admitted to your unit with a chronic SDH. Identify the priorities, approach, and techniques you would use to provide care for this patient in the preoperative phase of care. How will your priorities, approach, and techniques differ in the postoperative phase of care?
3. A 68-year-old woman was involved in a motor vehicle crash 2 days ago and sustained a T6 fracture with SCI. As a result, she has paraplegia and is in a neurologic intensive care unit. Identify the priorities, approach, and techniques you would use to provide care for this patient during the acute phase of care. Identify how your priorities, approach, and techniques will differ once the patient reaches the rehabilitation phase of care.

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicate classic reference.

Books

Arciniegas, D. B., Zasler, N. D., Vanderploeg, R. D., et al. (Eds.). (2013). Management of adults with traumatic brain injury. Arlington, VA: American Psychiatric Association.

Bader, M. K., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Booker, K. (2015). Critical care nursing: Monitoring and treatment for advanced nursing practice. Oxford: Wiley Blackwell.

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Eliopoulos, C. (2018). Gerontological nursing (9th ed.). Philadelphia, PA: Wolters Kluwer.

Herdman, T. H., & Kamitsuru, S. (Eds.). (2014). NANDA International nursing diagnoses: Definitions and classification, 2015–17. Oxford: Wiley-Blackwell.

Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

National Pressure Ulcer Advisory Panel. (2014). Prevention and treatment of pressure ulcers: Clinical practice guideline. Osborne Park, Western Australia: Cambridge Media.

Thomas, D. R. (2015). The relationship of nutrition and pressure ulcers. In C. W. Bales & C. S. Richis. (Eds). Handbook of clinical nutrition and aging. New York, NY: Springer.

West, T. A., Bergman, A., Biggins, M. S., et al. (2011). Care of the patient with mild traumatic brain injury: AANN and ARN clinical practice guidelines series. Glenview, IL: American Association of Neuroscience Nurses.

Wu, J. M., Matthews, C. A., Vaughan, C. P., et al. (2015). Urinary, fecal, and dual incontinence in older US adults. Journal of the American Geriatrics Society, 63(5), 947–953.

Journals and Electronic Documents

Abrams, G. M., & Wakasa, M. (2014). Chronic complications of spinal cord injury and disease. UpToDate. Retrieved on 2/24/17 at: www.uptodate.com/contents/chronic-complications-of-spinal-cord-injury-and-disease

American Spinal Injury Association (ASIA). (2016). International standards for neurological classification of spinal cord injury. Retrieved on 2/23/17 at: www.asia-spinalinjury.org/wp-content/uploads/2016/02/International_Stds_Diagram_Worksheet.pdf

Asselin, G., Ward, C., Penning, J. H., et al. (2012). Therapeutic horse back riding of a spinal cord injured veteran: a case study. Rehabilitation Nursing, 37(6), 270–276.

Bailes, J. D., Petraglia, A. L., Omalu, B. I., et al. (2013). Role of subconcussion in repetitive mild traumatic brain injury. Journal of Neurosurgery, 119(5), 1235–1245.

Bauman, M., & McCourt T. R. (2014) Assessing and managing patients with chronic subdural hematoma. American Nurse Today, 9(9), 38–41.

Beauchamp, M. R., Scarlett, L. J., Ruissen, G. R., et al. (2016). Peer mentoring of adults with spinal cord injury: a transformational leadership perspective. Disability & Rehabilitation, 38(19), 1884–1892.

Bodanapally, U. K., Sours, C., Zhuo, J., et al. (2015). Imaging of traumatic brain injury. Radiologic Clinics of North America, 53(4), 695–715.

Chacko, V., Joseph, B., Mohanty, S. P., & Jacob, T. (1986). Management of spinal cord injury in a general hospital in rural India. Spinal Cord, 24(5), 330.

Centers for Disease Control and Prevention (CDC). (2016a). Injury prevention & control: Traumatic brain injury & concussion. Retrieved on 2/9/2017 at: www.cdc.gov/traumaticbraininjury/get_the_facts.html

Centers for Disease Control and Prevention (CDC). (2016b). CDC study finds that adoption of the Brain Trauma Foundation guidelines could result in a substantial reduction in traumatic brain-injury-related deaths. Retrieved on 2/9/2017 at: www.cdc.gov/traumaticbraininjury/brain_trauma_guidelines.html

*Chuang, C., Yang, Y., & Kuo, L. T. (2015). Finding a way to cope: A qualitative study of the experience of persons with spinal cord injury. Journal of Neuroscience Nursing, 47(6), 313–319.

*Giusti, G. D., Tuteri, D., & Mirella, G. (2016). Nursing interactions with intensive care unit patients affected by sleep deprivation: an observational study. Dimensions of Critical Care Nursing, 35(3), 154–159.

Dauwe, P. B., Pulikkottil, B. J., Lavery, L., et al. (2014). Does hyperbaric oxygen therapy work in facilitating acute wound healing: A systematic review. Plastic and Reconstructive Surgery, 133(2), 208e–215e.

DiVita, M. A., Granger, C. V., Goldstein, R., et al. (2015). Risk factors for development of new or worsened pressure ulcers among patients in inpatient rehabilitation facilities in the United States: Data from the Uniform Data System for Medical Rehabilitation. Physical Medicine & Rehabilitation, 7(6), 599–612.

Duetzmann, S., Forsey, L. M., Senft, C., et al. (2015). Sacral peak pressure in healthy volunteers and patients with spinal cord injury. Nursing Research, 64(4), 300–305.

Dunk, A. M., & Carville, K. (2015). The international clinical practice guideline for prevention and treatment of pressure ulcers/injuries. Journal of Advanced Nursing, 72(2), 243–244.

García-Fernández, F. P., Agreda, J., Verdú, J., et al. (2014). A new theoretical model for the development of pressure ulcers and other dependence-related lesions. Journal of Nursing Scholarship, 46(1), 28–38.

Gorina, Y., Schappert, S., Bercovitz, A., et al. (2014). Prevalence of incontinence among older Americans. National Center for Health Statistics. Vital & Health Statistics, 3(36), 1–33.

Gould, L. J., Olney, C. M., Nichols, J. S., et al. (2014). Spinal cord injury survey to determine pressure ulcer vulnerability in the outpatient population. Medical Hypotheses, 83(5), 552–558.

Government of India. Ministry of Road Transport and Highways Transport Research Wing. (2020). Road accidents in India 2020. Retrieved on 06/11/2022 at: https://morth.nic.in/sites/default/files/RA_2020.pdf.

Griesdale, D. E., Örtenwall, V., Norena, M., et al. (2015). Adherence to guidelines for management of cerebral perfusion pressure and outcome in patients who have severe traumatic brain injury. Journal of Critical Care, 30(1), 111–115.

**Hagen, C., Malkmus, D., & Durham, P. (1972). The Rancho levels of cognitive functioning scale. Downey, CA: Communication Disorders Service, Rancho Los Amigos Hospital. Revised 11/15/74 by: Danese Malkmus and Kathryn Stenderup.

Hemphill, J. C., & Phan, N. (2016). Traumatic brain injury: Epidemiology, classification and pathophysiology. UpToDate. Retrieved on 2/18/2017 at: www.uptodate.com/contents/traumatic-brain-injury-epidemiology-classification-and-pathophysiology

Hollander, J. E., & Camacho, M. (2014). Assessment and management of scalp lacerations. UpToDate. Retrieved on 2/17/2017 at: www.uptodate.com/contents/assessment-and-management-of-scalp-lacerations

Horn, S. D., Kinikini, M., Moore, L. W., et al. (2015). Enteral nutrition for patients with traumatic brain injury in the rehabilitation setting: Associations with patient preinjury and injury characteristics and outcomes. Archives of Physical Medicine and Rehabilitation, 96(8), S245–S255.

Hyatt, K. S. (2014). Mild traumatic brain injury. American Journal of Nursing, 114(11), 36–42.

Jia, X., Kowalski, R. G., Sciubba, D. M., et al. (2013). Critical care of the traumatic spinal cord injury. Journal of Intensive Care Medicine, 28(1), 12–23.

Larrow, V., & Klich-Heartt, E. I. (2016). Prevention of ventilator-associated pneumonia in the intensive care unit: beyond the basics. Journal of Neuroscience Nursing, 48(3), 160–165.

Lieberman, J., Goff, D., Hammond, F., et al. (2014). Dietary intake and adherence to the 2010 guidelines for Americans among individuals with chronic spinal cord injury: a pilot study. Journal of Spinal Cord Medicine, 37(6), 751–757.

Madden, L. K., & DeVon, H. (2015). A systematic review of the effects of body temperature on outcome after adult traumatic brain injury. Journal of Neuroscience Nursing, 47(4), 190–203.
Mandl, M., Halfens, R. J., & Lohrmann, C. (2015). Incontinence care in nursing homes: A cross-sectional study. Journal of Advanced Nursing, 71(9), 2142–2152
Mathur, N., Jain, S., Kumar, N., Srivastava., A., Purohit, N., & Patni, A. (2015). Spinal cord injury: scenario in an Indian state. Spinal Cord, 53(5), 349.
McNett, M. M., & Olson, D. M. (2013). Evidence to guide nursing interventions for critically ill neurologically impaired patients with ICP monitoring. Journal of Neuroscience Nursing, 45(3), 120–123.
Mills, P. B., Fung, C. K., Travios, A., et al. (2015). Nonpharmacologic management of orthostatic hypotension: a systematic review. Archives of Physical Medicine and Rehabilitation, 96(2), 366–375.
*Mitchell, P. H., Kirkness, C., & Blissitt, P. A. (2015). Cerebral perfusion pressure and intracranial pressure in traumatic brain injury. Annual Review of Nursing Research, 33(1), 111–183.
Mohit, A. A. (2016). Cellular events and pathophysiology of SCI. Spine (Phila Pa 1976), 41(Suppl 7), S28.National Spinal Cord Injury Statistical Center (NSCISC). (2016). Spinal Cord Injury (SCI) facts and figures at a glance. Retrieved on 2/23/2017 at: www.nscisc.uab.edu/Public/Facts%202016.pdf.
Ning, G.-Z., Wu, Q., Li, Y.-L., & Feng, S.-Q. (2012). Epidemiology of traumatic spinal cord injury in Asia: a systematic review. The Journal of Spinal Cord Medicine, 35(4), 229–239.
*Olson, D. M., Rogers, M. S., & Stutzman, S. (2015). Electronic medical record validation: Exploring the reliability of intracranial pressure data abstracted from the electronic medical record-pilot. Journal of Nursing Measurement, 23(3), 532–540.
Pebdani, R. N., Johnson, K. L., & Amtmann, D. (2014). Personal experiences of pregnancy and fertility in individuals with spinal cord injury. Sexuality and Disability, 32(1), 65–74.
Perez-Barcena, J., Llompart-Pou, J., & O'Phelan, K. H. (2014). Intracranial pressure monitoring and management of intracranial hypertension. Critical Care Clinics, 30(4), 735–750.
Posthauer, M. E., Banks, M., Dorner, B., et al. (2015). The role of nutrition for pressure ulcer management: national pressure ulcer advisory panel, European pressure ulcer advisory panel, and pan pacific pressure injury alliance white paper. Advances in Skin & Wound Care, 28(4), 175–188.
Qaseem, A., Humphrey, L. L., Forciea, M. A., et al. (2015). Treatment of pressure ulcers: A clinical practice guideline from the American College of Physicians. Annals of Internal Medicine, 162(5), 370–379.
Rodriguez, G. M. (2016). Bowel function after spinal cord injury. Archives of Physical Medicine and Rehabilitation, 97(2), 339–340.
Roe, B., Flanagan, L., & Maden, M. (2015). Systematic review of systematic reviews for the management of urinary incontinence and promotion of continence using conservative behavioural approaches in older people in care homes. Journal of Advanced Nursing, 71(7), 1464–1483.
Saha, S., Smith, M. E. B., Totten, A., et al. (2013). Pressure ulcer treatment strategies: Comparative effectiveness. Comparative Effectiveness Review No. 90. (Prepared by the Oregon Evidence-based Practice Center under Contract No. 290–2007–10057-I.). Retrieved on 8/20/2015 at: ww.effectivehealthcare.ahrq.gov/reports/final.cfm.
Saunders, L. L., Clarke, A., Tate, D. G., et al. (2015). Lifetime prevalence of chronic health conditions among persons with spinal cord injury. Archives of Physical Medicine and Rehabilitation, 96(4), 673–679.
Scheel-Sailer, A., Wyss, A., Boldt, C., et al. (2013). Prevalence, location, grade of pressure ulcers and association with specific patient characteristics in adult spinal cord injury patients during the hospital stay: A prospective cohort study. Spinal Cord, 51(11), 828–833.
Singh, R., Sharma, S. C., Mittal, R., & Sharma, A. (2003). Traumatic spinal cord injuries in Haryana: an epidemiological study. Indian J Community Med, 28(4), 184–186.
Stocchetti, N., & Maas, A. I. (2014). Traumatic intracranial hypertension. New England Journal of Medicine, 370(22), 2121–2130.
Stoekenbroek, R. M., Santema, T. B., Legemate, D. A., et al. (2014). Hyperbaric oxygen for the treatment of diabetic foot ulcers: A systematic review. European Journal of Vascular and Endovascular Surgery, 47(6), 647–655.
Stifter, J., Yao, Y., Lodhi, M.K., et al. (2015). Nurse continuity and hospital-acquired pressure ulcers. Nursing Research, 64(5), 361–371.
Sullivan, N., & Schoelles, K. M. (2013). Preventing in-facility pressure ulcers as a patient safety strategy: A systematic review. Annals of Internal Medicine, 158(5), 410–416.
Tam, S., McKay, A., Sloan, S., et al. (2015). The experience of challenging behaviours following a severe TBI: a family perspective. Brain Injury, 29(7–8), 813–821.
**Teasdale, G., & Jennett, B. (1974). Assessment of coma and impaired consciousness. A practical scale. Lancet, 2(7872), 81–84.
Wan, D., & Krassioukov, A. V. (2014). Life-threatening outcomes associated with autonomic dysreflexia: a clinical review. The Journal of Spinal Cord Medicine, 37(1), 2–10.
Wang, H., Niewczyk, P., DiVita, M., et al. (2014). Impact of pressure ulcers on outcomes in inpatient rehabilitation facilities. American Journal of Physical Medicine & Rehabilitation, 93(3), 207–216.
Wiggermann, N., Kotowski, S., Davis, K., et al. (2015). The effect of patient migration in bed on torso elevation. Nursing Research, 64(3), 221–225.
Wilson, M., & DellaPenna, A. (2015). Targeted temperature modulation in the neuroscience patient. Critical Care Nursing Clinics of North America, 28(1), 125–136.
Zaman, A., Dubiel, R., Driver, S., et al. (2017). Seizure prophylaxis guidelines following traumatic brain injury: An evaluation of compliance. Journal of Head Trauma Rehabilitation, 32(2), E13–E17.

Resources

American Association of Neuroscience Nurses (AANN), www.aann.org
American Academy of Spinal Cord Injury Professionals, Inc., www.academyscipro.org
Association of Rehabilitation Nurses (ARN), www.rehabnurse.org
Brain Injury Association of America, www.biausa.org
Brain Trauma Foundation, www.braintrauma.org
Centers for Disease Control and Prevention (CDC), www.cdc.gov
Information Center for Individuals with Disabilities, www.disability.net
National Pressure Ulcer Advisory Panel (NPUAP), www.npuap.org
National Rehabilitation Information Center (NARIC), www.naric.com
National Spinal Cord Injury Association (NSCIA), www.spinalcord.org
Paralyzed Veterans of America, www.pva.org
Traumatic Brain Injury, http://indianheadinjuryfoundation.org/traumatic-brain-injury-2/

CHAPTER 52

Management of Patients with Neurologic Infections, Autoimmune Disorders, and Neuropathies

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Differentiate among the infectious disorders of the nervous system according to causes, manifestations, medical care, and nursing management.
2. Describe the pathophysiology, clinical manifestations, and medical and nursing management of multiple sclerosis, myasthenia gravis, and Guillain–Barré syndrome.
3. Use the nursing process as a framework for care of patients with multiple sclerosis and Guillain–Barré syndrome.
4. Explain disorders of the cranial nerves, their manifestations, and indicated nursing interventions.
5. Apply the nursing process as a framework for care of the patient with a cranial nerve disorder.

GLOSSARY

ataxia: impaired coordination of movement during voluntary movement
diplopia: double vision, or the awareness of two images of the same object occurring in one or both eyes
dysphagia: difficulty swallowing
dysphonia: voice impairment or altered voice production
hemiparesis: weakness of one side of the body, or part of it, due to an injury in the motor area of the brain
hemiplegia: paralysis of one side of the body, or part of it, due to an injury in the motor area of the brain
neuropathy: general term indicating a disorder of the nervous system
paresthesia: numbness, tingling, or a "pins and needles" sensation
prion: a pathogen smaller than a virus that is resistant to standard sterilization procedures
ptosis: drooping of the eyelids
spasticity: muscular hypertonicity with increased resistance to stretch often associated with weakness, increased deep tendon reflexes, and diminished superficial reflexes

Introduction

The diverse group of neurologic disorders that make up infectious and autoimmune disorders and cranial and peripheral neuropathies presents unique challenges for nursing care. The nurse who cares for patients with these disorders must have a clear understanding of the pathophysiology, diagnostic testing, medical and nursing care, and rehabilitation processes. Some of the issues nurses must help patients and families confront include adaptation to the effects of the disease, potential changes in family dynamics, and end-of-life issues.

INFECTIOUS NEUROLOGIC DISORDERS

The infectious disorders of the nervous system include meningitis, brain abscesses, various types of encephalitis, Creutzfeldt–Jakob disease (CJD), and variant Creutzfeldt–Jakob disease (vCJD). The clinical manifestations, assessment, and diagnostic findings, as well as the medical and nursing management, are related to the specific infectious process.

Meningitis

Meningitis is inflammation of the meninges, which cover and protect the brain and spinal cord. The three major causes of meningitis are bacterial, viral, and fungal infections (Bader, Littlejohns, & Olson, 2016). Meningitis can be the main reason a patient is hospitalized, or it can develop during hospitalization; it is classified as septic or aseptic. Septic meningitis is caused by bacteria. The bacteria *Streptococcus pneumoniae* and *Neisseria meningitidis* are responsible for the majority of cases of bacterial meningitis in adults. In aseptic meningitis, the cause is viral or secondary to cancer or having a weakened immune system, such as in human immune deficiency virus (HIV). The most common causative agents are the enteroviruses. Aseptic meningitis occurs more frequently in the summer and early fall.

Outbreaks of *N. meningitidis* infection are most likely to occur in dense community groups, such as college campuses and military installations. Although infections occur year-round, epidemic period corresponds with the end of winter (November–March) and the beginning of summer (April–July) in India (Sinclair, Preziosi, John, et al., 2010). Factors that increase the risk of bacterial meningitis include tobacco use and viral upper respiratory infection, because they increase the amount of droplet production. Otitis media and mastoiditis increase the risk of bacterial meningitis, because the bacteria can cross the epithelial membrane and enter the subarachnoid space. People with immune system deficiencies are also at greater risk for development of bacterial meningitis (Bader et al., 2016).

Pathophysiology

Meningeal infections generally originate in one of two ways: through the bloodstream as a consequence of other infections or by direct spread, such as might occur after a traumatic injury to the facial bones or secondary to invasive procedures.

The *N. meningitidis* bacteria exists in the throats and nasal passages of approximately 10% of the general population and

Chart 52-1

Meningitis in Specific Populations

Meningitis can occur as a complication of other diseases and is an opportunistic infection seen with greater frequency in patients who are immunocompromised.

Meningitis in Patients with Acquired Immune Deficiency Syndrome (AIDS)

- Cryptococcal meningitis is the most common fungal infection of the central nervous system in patients with AIDS. Patients may experience headache, nausea, vomiting, seizures, confusion, and lethargy. Treatment consists of IV administration of amphotericin B followed by fluconazole. Maintenance therapy with fluconazole may be necessary to prevent relapse.
- Some patients who are immunosuppressed develop few if any symptoms because of blunted inflammatory responses; others develop atypical features.
- Onset of fever, headache, nausea, and malaise most often occur over a few weeks. Only 25% of patients present with stiff neck and photophobia.

Meningitis in Patients with Lyme Disease

- Lyme disease is a multisystem inflammatory process caused by the tick-transmitted spirochete *Borrelia burgdorferi*.
- Neurologic deficits are seen in later stages (stages 2 or 3). Stage 2 occurs with the start of a characteristic rash or 1–6 months after the rash has disappeared.
- Neurologic comorbidities include aseptic meningitis, chronic lymphocytic meningitis, and encephalitis.
- Cranial nerve inflammation, including Bell palsy and other peripheral neuropathies, is common.
- Stage 3 (the chronic form of the disease) begins years after the initial tick infection and is characterized by arthritis, skin lesions, and neurologic abnormalities.
- Most patients with stage 2 and 3 Lyme disease are treated with IV antibiotics, usually ceftriaxone or penicillin G.
- Meningeal and systemic symptoms begin to improve within days, although other symptoms, such as headache, may persist for weeks.

Adapted from Theroux, N., Phipps, M., Zimmerman, L., & Relf, M. V. (2013). Neurological complications associated with HIV and AIDS: Clinical implications for nursing. Journal of Neuroscience Nursing, 45(1), 5–13.

is transmitted by secretion or aerosol contamination (National Meningitis Association, 2016). Bacterial or meningococcal meningitis also occurs as an opportunistic infection in patients with acquired immune deficiency syndrome (AIDS) and as a complication of Lyme disease (see Chart 52-1).

Once the causative organism enters the bloodstream, it crosses the blood–brain barrier and proliferates in the cerebrospinal fluid (CSF). The host immune response stimulates the release of cell wall fragments and lipopolysaccharides, facilitating inflammation of the subarachnoid and pia mater. Because the cranial vault contains little room for expansion, the inflammation may cause increased intracranial pressure (ICP). CSF circulates through the subarachnoid space, where inflammatory cellular materials from the affected meningeal tissue enter and accumulate.

The prognosis for bacterial meningitis depends on the causative organism, the severity of the infection and illness, and the timeliness of treatment. Acute fulminant presentation may include adrenal damage, circulatory collapse, and widespread hemorrhages (Waterhouse–Friderichsen syndrome). This

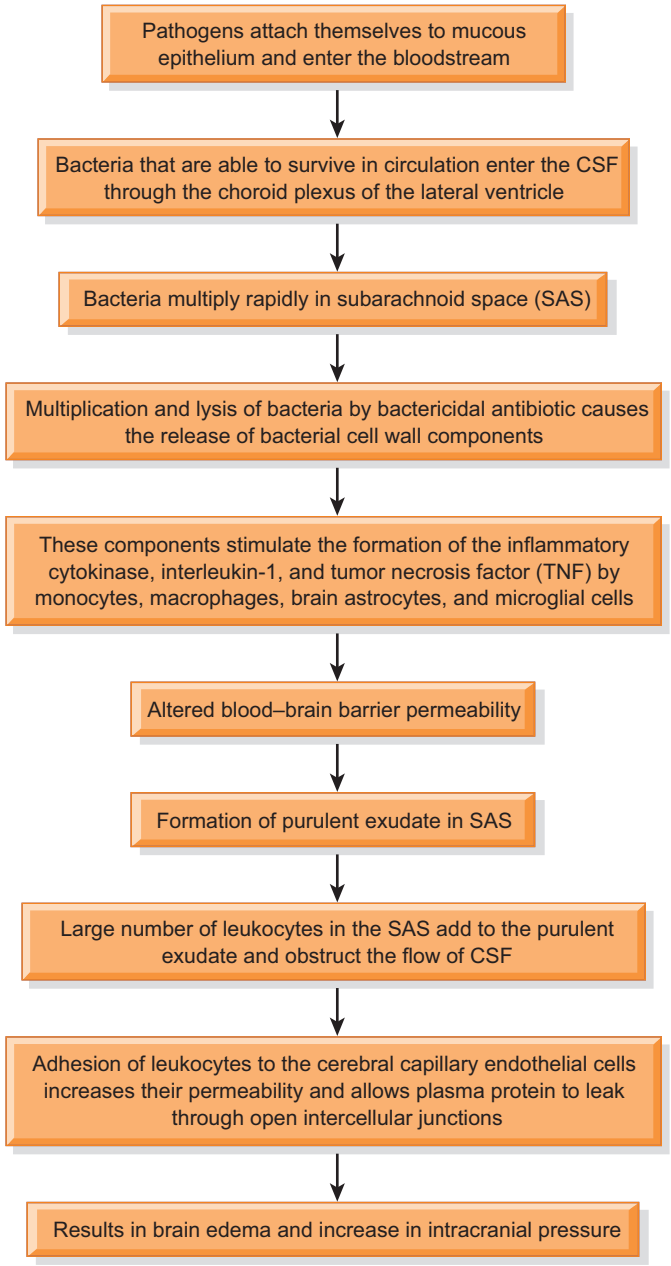


Figure 52-1 • Pathophysiology of meningitis. CSF, cerebrospinal fluid.

syndrome is the result of endothelial damage and vascular necrosis caused by the bacteria. Complications include visual impairment, deafness, seizures, paralysis, hydrocephalus, and septic shock. Pathophysiology of meningitis is presented in Figure 52-1.

Clinical Manifestations

Headache and fever are frequently the initial symptoms. Fever tends to remain high throughout the course of the illness. The headache is usually either steady or throbbing and very severe as a result of meningeal irritation (Weber & Kelley, 2014). Meningeal irritation results in a number of other well-recognized signs common to all types of meningitis:

- **Neck immobility:** A stiff and painful neck (nuchal rigidity) can be an early sign, and any attempts at flexion of the head are difficult because of spasms in the muscles of the neck.

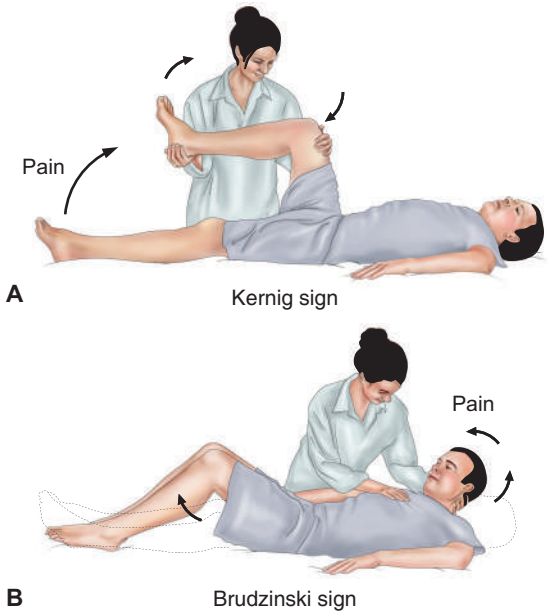


Figure 52-2 • Testing for meningeal irritation. **A**. Kernig sign. Flex the patient's leg at both the hip and knee and then straighten the knee. **B**. Brudzinski sign. As the neck is flexed, watch the hips and knees for a reaction.

Usually, the neck is supple, and the patient can easily bend the head and neck forward.

- **Positive Kernig sign:** When the patient is lying with the thigh flexed on the abdomen, the leg cannot be completely extended (see Fig. 52-2). When Kernig sign is bilateral, meningeal irritation is suspected (Weber & Kelley, 2014).
- **Positive Brudzinski sign:** When the patient's neck is flexed (after ruling out cervical trauma or injury), flexion of the knees and hips is produced; when the lower extremity of one side is passively flexed, a similar movement is seen in the opposite extremity (see Fig. 52-2). Brudzinski sign is a more sensitive indicator of meningeal irritation than Kernig sign.
- **Photophobia (extreme sensitivity to light):** This finding is common due to irritation of the meninges, especially around the diaphragm sellae (Digre & Brennan, 2012).
- A rash can be a striking feature of *N. meningitidis* infection, occurring in about half of patients with this type of meningitis. Skin lesions develop, ranging from a petechial rash with purpuric lesions to large areas of ecchymosis.

Disorientation and memory impairment are common early in the course of the illness. The changes depend on the severity of the infection as well as the individual response to the physiologic processes. Behavioral manifestations are also common. As the illness progresses, lethargy, unresponsiveness, and coma may develop.

Seizures can occur and are the result of areas of irritability in the brain. ICP increases secondary to diffuse brain swelling or hydrocephalus (Bader et al., 2016). The initial signs of increased ICP include decreased level of consciousness (LOC) and focal motor deficits. If ICP is not controlled, the uncus of the temporal lobe may herniate through the tentorium, causing pressure on the brainstem. Brainstem herniation is a life-threatening event that causes cranial nerve dysfunction and depresses the centers of vital functions, such as the medulla. See Chapter 49 for discussion of the patient with a change in LOC or increased ICP.

An acute fulminant infection occurs in about 10% of patients with meningococcal meningitis, producing signs of sepsis: an abrupt onset of high fever, extensive purpuric lesions (over the face and extremities), shock, and signs of disseminated intravascular coagulation (see Chapter 27). Death may occur within a few hours after onset of the infection.

Assessment and Diagnostic Findings

If the clinical presentation suggests meningitis, diagnostic testing is conducted to identify the causative organism. A computed tomography (CT) scan is used to detect a shift in brain contents (which may lead to herniation) prior to a lumbar puncture in patient with altered LOC, papilledema, neurologic deficits, new onset of seizure, immunocompromised state, or history of central nervous system (CNS) disease. Bacterial culture and Gram staining of CSF and blood are key diagnostic tests (Bader et al., 2016). An overview of CSF values and alterations in bacterial, viral, and fungal meningitis is presented in Table 52-1. Gram staining allows for rapid identification of the causative bacteria and initiation of appropriate antibiotic therapy.

Prevention

The Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention (CDC, 2016) recommends that the meningococcal conjugated vaccine be given to youth at 11 to 12 years of age, with a booster dose at 16 years of age. First-year college students and members of the military who have not been vaccinated are at higher risk.

TABLE 52-1 Cerebrospinal Fluid Values Diagnostic for Meningitis

Parameter	Normal CSF	Bacterial Meningitis	Viral Meningitis	Fungal Meningitis
Opening pressure (mm H_2O)	100–180	200–500	≤250	>200
Leukocyte count (white blood cell/mm^3)	0–5	Increased 100–5000	Increased 50–1000	Increased >20
Neutrophils (%)	0	≥80	<40	
Protein (mg/dL)	18–45	Elevated 100–500	Elevated <200	Elevated >45
Glucose (mg/dL)	45–80; 0.6 times blood glucose level	<40; <0.4 times blood glucose level	>45	<40

CSF, cerebrospinal fluid.

Adapted from Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

People in close contact with patients with meningococcal meningitis should be treated with antimicrobial chemoprophylaxis using rifampin (Rifadin), ciprofloxacin hydrochloride (Cipro), or ceftriaxone sodium (Rocephin). Therapy should be started within 24 hours after exposure because a delay limits the effectiveness of the prophylaxis. Vaccination should also be considered as an adjunct to antibiotic chemoprophylaxis for anyone living with a person who develops meningococcal infection. Vaccination against *Haemophilus influenzae* and *S. pneumoniae* should be encouraged for children and adults who are at-risk (CDC, 2016).

Medical Management

Successful outcomes depend on the early administration of an antibiotic agent that crosses the blood–brain barrier into the subarachnoid space in sufficient concentration to halt the multiplication of bacteria. Penicillin G in combination with one of the cephalosporins (e.g., ceftriaxone sodium, cefotaxime sodium) is most often administered intravenously (IV), optimally within 30 minutes of hospital arrival (Bader et al., 2016).

Dexamethasone has been shown to be beneficial as adjunct therapy in the treatment of acute bacterial meningitis and in pneumococcal meningitis if it is given 15 to 20 minutes before the first dose of antibiotic and every 6 hours for the next 4 days. Research suggests that dexamethasone improves the outcome in adults and does not increase the risk of gastrointestinal bleeding (Bader et al., 2016).

Dehydration and shock are treated with fluid volume expanders. Seizures, which may occur early in the course of the disease, are treated with anticonvulsant medications. Increased ICP is treated as necessary (see Chapter 49).

Nursing Management

The patient with meningitis is critically ill; therefore, many of the nursing interventions are collaborative with the physician, respiratory therapist, and other members of the health care team. The patient's safety and well-being depend on sound nursing judgment. Most patients will need the following nursing interventions:

- Instituting infection control precautions until 24 hours after initiation of antibiotic therapy (oral and nasal discharge is considered infectious)
- Assisting with pain management due to overall body aches and neck pain
- Assisting with getting rest in a quiet, darkened room
- Implementing interventions to treat the elevated temperature, such as antipyretic agents and cooling blankets
- Encouraging the patient to stay hydrated either orally or peripherally
- Ensuring close neurologic monitoring (see Chapter 49)

Neurologic status and vital signs are continually assessed. Pulse oximetry and arterial blood gas values are used to quickly identify the need for respiratory support if increasing ICP compromises the brainstem. Insertion of a cuffed endotracheal tube (or tracheotomy) and mechanical ventilation may be necessary to maintain adequate tissue oxygenation.

Blood pressure (usually monitored using an arterial line) is assessed for early manifestations of shock, which precedes cardiac or respiratory failure. Rapid IV fluid replacement may be prescribed, but care is taken to prevent fluid overload. Fever also increases the workload of the heart and cerebral metabolism. ICP will increase in response to increased cerebral metabolic demands. Therefore, measures are taken to reduce body temperature as quickly as possible.

Other important components of nursing care include the following measures:

- Protecting the patient from injury secondary to seizure activity or altered LOC
- Monitoring daily body weight; serum electrolytes; and urine volume, specific gravity, and osmolality, especially if syndrome of inappropriate antidiuretic hormone (SIADH) is suspected
- Preventing complications associated with immobility, such as pressure ulcers and pneumonia

Any sudden, critical illness can be devastating to the family. Because the patient's condition is often critical and the prognosis guarded, the family needs to be informed about the patient's condition. Periodic family visits are essential to facilitate coping of the patient and family. An important aspect of the nurse's role is to support the family and assist them in identifying others who can be supportive to them during the crisis.

Promoting Home, Community-Based, and Transitional Care

After the patient has achieved physiologic homeostasis and has demonstrated achievement of major health care goals, rehabilitation continues either in a rehabilitation facility, skilled nursing facility or at home. Continued support and evaluation by the nurse are essential.

Because patients may have been critically ill and focused on the most obvious needs and issues, the nurse reminds the patient and family about the importance of continuing health-promotion and screening practices, such as regular physical examinations and appropriate diagnostic screening tests.

Brain Abscess

Brain abscesses account for approximately 8% of intracranial masses in developing countries and 1–2% in the western countries (Muzumdar, Jhawar, & Goel et al, 2011). Brain abscesses are rare in people who are immunocompetent; they are more frequently diagnosed in people who are immunosuppressed as a result of an underlying disease or the use of immunosuppressive medications.

Pathophysiology

A brain abscess is a collection of infectious material within the tissue of the brain. Bacteria are the most common causative organisms. The most common predisposing conditions for abscesses among adults who are immunocompetent are otitis media and rhinosinusitis. It is estimated that 40% of brain abscesses are otogenic in origin (Bader et al., 2016). An abscess can result from intracranial surgery, penetrating head injury, or tongue piercing. Organisms causing brain abscess may reach the brain by hematologic spread from the lungs, gums, tongue, or heart, or from a wound or intra-abdominal infection. Pathophysiology is presented in Figure 52-3.

Clinical Manifestations

The clinical manifestations of a brain abscess result from alterations in intracranial dynamics (edema, brain shift), infection, or the location of the abscess. Headache, usually worse in the morning, is the most prevalent symptom. Fever is

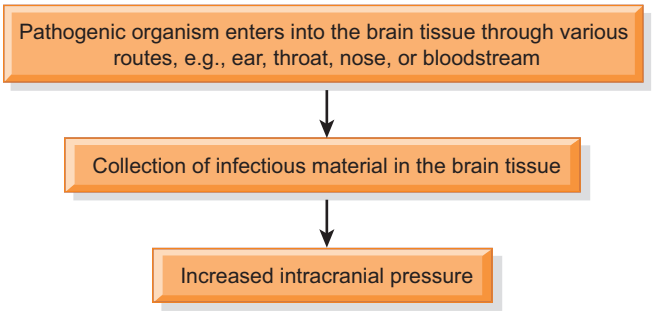


Figure 52-3 • Pathophysiology of brain abscess.

present 50% of the time (Slazinski, 2013). Vomiting and focal neurologic deficits occur as well. Focal deficits include weakness and decreasing vision reflect the area of brain that is involved. As the abscess expands, symptoms of increased ICP such as decreasing LOC and seizures occur.

Assessment and Diagnostic Findings

The baseline neurologic examination may reveal a variety of signs and symptoms based on the location of the abscess (see Chart 52-2). Neuroimaging with CT scanning with contrast is used most often to identify the size and location of the abscess. Cerebritis is a small infection in the brain that can progress to an abscess if not detected or treated. Aspiration of the abscess, guided by CT or MRI, is often used to culture and identify the infectious organism. MRI is the preferred study, because it is more sensitive to cerebritis and detecting smaller lesions (Slazinski, 2013). Blood cultures are obtained if the abscess is believed to arise from a distant source. Chest x-ray is performed to rule out predisposing lung infections, and electroencephalography (EEG) may help localize the lesion (Hickey, 2014).

Medical Management

Treatment is aimed at controlling increased ICP, draining the abscess, and providing antimicrobial therapy directed at the abscess and the main source of infection. Large IV doses of antibiotic agents are given to penetrate the blood–brain barrier and reach the abscess. The choice of the specific antibiotic medication is based on culture and sensitivity testing and directed at the causative organism. Antibiotics should be started as soon as possible and thus the initial antibiotic started typically is ceftriaxone, which will be adjusted based on the culture and sensitivity results. A stereotactic CT-guided aspiration may be used to drain the abscess and identify the causative organism. Surgical excision is the preferred method, but is not done as often as needle aspiration due to higher risk of neurologic complications (Slazinski, 2013). Corticosteroids may be prescribed to help reduce the inflammatory cerebral edema if the patient shows evidence of an increasing neurologic deficit. Anticonvulsant medications may be prescribed to prevent or treat seizures (see Chapter 49).

Chart 52-2 ASSESSMENT

Assessing for Brain Abscesses

Be alert to the following signs and symptoms of brain abscess:

Frontal Lobe

- Expressive aphasia (inability to express oneself)
- Frontal headache
- Hemiparesis (weakness on one side of the body)
- Seizures

Temporal Lobe

- Changes in vision
- Facial weakness
- Localized headache
- Receptive aphasia (inability to understand language)

Cerebellar Abscess

- Ataxia (inability to coordinate movements)
- Nystagmus (rhythmic, involuntary movements of the eye)
- Occipital headache

Nursing Management

Nursing care focuses on continuing to assess the neurologic status, administering medications, assessing the response to treatment, and providing supportive care.

Ongoing neurologic assessment alerts the nurse to changes in ICP, which may indicate a need for more aggressive intervention. The nurse also assesses and documents the responses to medications. Blood laboratory test results, specifically blood glucose and serum potassium levels, need to be closely monitored when corticosteroids are prescribed (Comerford, 2015). Administration of insulin or electrolyte replacement may be required to return these values to within normal limits.

Patient safety is another key nursing responsibility. Injury may result from decreased LOC or falls related to motor weakness or seizures.

The patient with a brain abscess is very ill, with neurologic deficits, such as hemiplegia (paralysis of one side of the body, or part of it), hemiparesis (weakness of one side of the body, or part of it), seizures, visual deficits, and cranial nerve palsies that may persist after treatment. The nurse must assess the family's ability to express distress at the patient's condition, cope with the patient's illness and deficits, and obtain support.

Herpes Simplex Encephalitis

Encephalitis is an acute inflammatory process of the brain tissue. The herpes simplex virus (HSV) is one of the most common cause of acute encephalitis, which is more common in the western world (Bader et al., 2016).

Pathophysiology

The pathology of encephalitis involves local necrotizing hemorrhage that becomes more generalized, followed by edema. There is also progressive deterioration of nerve cell bodies (Grossman & Porth, 2014).

Clinical Manifestations

The initial symptoms of herpes simplex encephalitis include fever, headache, confusion, and hallucinations. Focal neurologic symptoms reflect the areas of cerebral inflammation and necrosis and include fever, headache, behavioral changes, focal seizures, dysphasia, hemiparesis, and altered LOC (Grossman & Porth, 2014).

Assessment and Diagnostic Findings

Neuroimaging studies, such as EEG, and CSF examination are used to diagnose encephalitis. MRI is used to detect early changes caused by herpes simplex; scans usually show edema in the frontal and temporal lobes. The EEG shows diffuse slowing or focal changes in the temporal lobe in the majority of patients. Lumbar puncture often reveals a high opening pressure, glucose within normal limits, and high protein levels in CSF samples (see Table 52-1). Twenty percent of initial CSF studies have results within normal limits (Bader et al., 2016). Viral cultures are almost always negative. The polymerase chain reaction (PCR) is the standard test for early diagnosis of herpes simplex encephalitis. PCR identifies the deoxyribonucleic acid (DNA) bands of HSV-1 in the CSF. The validity of PCR is very high between the 3rd and 10th days after symptom onset.

Medical Management

Antiviral agents, either acyclovir (Zovirax) or ganciclovir (Cytovene), are the medications of choice in the treatment for HSV (Comerford, 2015). Early administration of antiviral agents (usually well tolerated) improves the prognosis associated with herpes simplex encephalitis. The mode of action is inhibition of viral DNA replication. To prevent relapse, treatment should continue for up to 3 weeks. Slow IV administration over 1 hour prevents crystallization of the medication in the urine. The usual dose of acyclovir is decreased if the patient has a history of renal insufficiency.

Nursing Management

Assessment of neurologic function is key to monitoring the progression of disease. Comfort measures to reduce headache include dimming the lights, limiting noise and visitors, grouping nursing interventions, and administering analgesic agents. Opioid analgesic medications may mask neurologic symptoms; therefore, they are used cautiously. Seizures and altered LOC require care directed at injury prevention and safety. Nursing care addressing patient and family anxieties is ongoing throughout the illness. Monitoring of blood chemistry test results and urinary output alert the nurse to the presence of renal complications related to antiviral therapy.

Arthropod-Borne Virus Encephalitis

Arthropod-borne viruses, or arboviruses, are maintained in nature through biologic transmission between susceptible vertebrate hosts by blood feeding arthropods (mosquitoes, psychodids, ceratopogonids, and ticks). Arthropod vectors transmit several types of viruses that cause encephalitis. The main vector is the mosquito. Arbovirus infection (transmitted by arthropod vectors) occurs in specific geographic areas during the summer and fall. (Bader et al., 2016).

Pathophysiology

Viral replication occurs at the site of the mosquito bite. The host immune response attempts to control viral replication. If the immune response is inadequate, viremia will ensue. The virus gains access to the CNS via the olfactory tract, resulting in encephalitis. It spreads from neuron to neuron, predominantly affecting the cortical gray matter, the brainstem, and the thalamus. Meningeal exudates compound the clinical presentation by irritating the meninges and increasing ICP (Fig. 52-4).

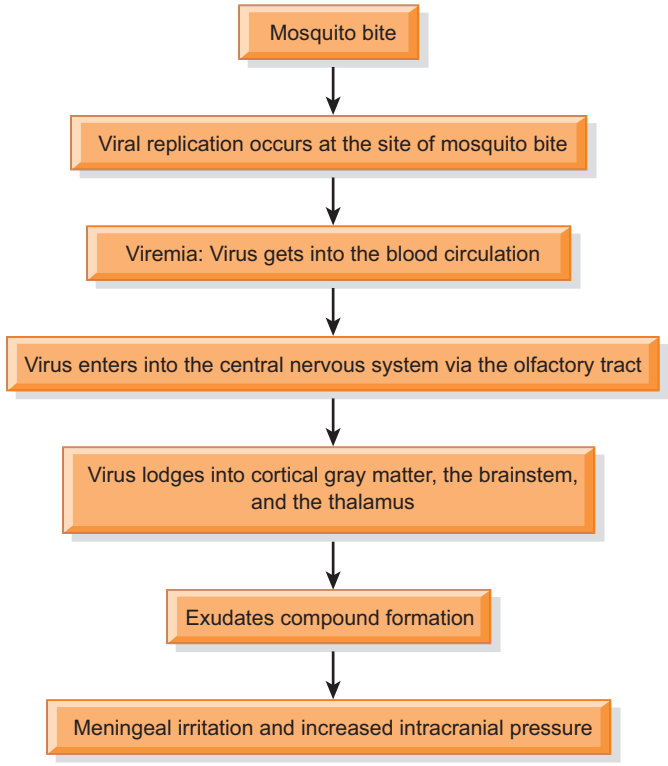


Figure 52-4 • Pathophysiology of arthropod-borne virus encephalitis.

Clinical Manifestations

St. Louis and West Nile virus encephalitis most commonly affect adults. An arboviral encephalitis occurs along a continuum with some cases having only flulike symptoms (i.e., headache and fever) but others progressing to specific neurologic manifestations that vary depending on the viral type (Bader et al., 2016). A unique clinical feature of St. Louis encephalitis is SIADH with hyponatremia. The incubation period in St. Louis encephalitis is from 4 to 12 days (Bader et al., 2016). Onset of symptoms is abrupt with fever, headache, dizziness, nausea, and malaise. If the disease spreads to the CNS, symptoms include stiff neck, confusion, dizziness, and tremors. Coma can occur in severe cases, and mortality increases with age. Eastern equine encephalitis has the highest mortality rate at 50% to 70% (Bader et al., 2016). Seizures, a poor prognostic indicator, are present in encephalitis and are more common in the St. Louis type.

One of the most common form of viral encephalitis in Asia is the Japanese encephalitis virus (JEV) caused by mosquito-borne flavivirus. The disease belongs to the same genus as dengue, yellow, and West Nile viruses. JEV primarily affects children as most adults tend to attain natural immunity from the disease (Tiwari, Singh, Tiwari, et al., 2012).

Assessment and Diagnostic Findings

Preliminary diagnosis is based on clinical presentation and location and dates of recent travel because certain viruses are endemic to certain geographic locales. Neuroimaging and CSF evaluation are useful in the diagnosis of encephalitis. The MRI scan demonstrates inflammation of the basal ganglia in cases of St. Louis encephalitis and inflammation in the periventricular area in cases of West Nile encephalitis. Immunoglobulin M antibodies to West Nile virus are observed in serum and CSF.

Serum cultures are not useful, because the viremia is brief. EEG can identify abnormal brain waves, which can help identify some viral infections.

Medical Management

No specific medication for arboviral encephalitis exists; therefore, symptom management is key. Controlling the seizures and the increased ICP are critical components of care in cases with neurologic manifestations. Interferon may be useful in treating St. Louis encephalitis, although no specific drug is indicated. Neuropsychiatric complications, such as emotional outbursts and other behavior changes, occur frequently.

Nursing Management

Many patients, particularly those with only fever and headache, are treated on an outpatient basis. If the patient is very ill, hospitalization may be required. The nurse carefully assesses neurologic status and identifies improvement or deterioration in the patient's condition. Injury prevention is key in light of the potential for falls or seizures. Any encephalitis that progresses may result in death or lifelong residual health issues such as neurologic deficits and seizures. The family will need support and education to cope with these outcomes.

Public education addressing the prevention of arboviral encephalitis is a key nursing role. Clothing that provides coverage and insect repellents containing 20% to 35% diethyltoluamide (DEET) should be used on exposed clothing and skin in high-risk areas to decrease mosquito and tick bites (Bader et al., 2016). Remaining indoors at dawn and dusk when mosquito activity is highest is recommended. Screens should be in good repair in the home, and standing water should be removed. All cases of arboviral encephalitis must be reported to the local health department.

Fungal Encephalitis

Fungal infections of the CNS occur rarely in people who are healthy. The presentation of fungal encephalitis is related to geographic area or to an immune system that is compromised due to disease or immunosuppressive medication. Causes of fungal infections include *Cryptococcus neoformans, Blastomyces dermatitidis, Histoplasma capsulatum, Aspergillus fumigatus, Candida,* and *Coccidioides immitis* (Bader et al., 2016). It is a risk for coal miners, construction workers, and farmers. *C. neoformans* is associated with exposure to bird droppings and may be seen in bird handlers.

Pathophysiology

The fungal spores enter the body via inhalation. They initially infect the lungs, causing vague respiratory symptoms or pneumonitis. The fungi may enter the bloodstream, causing a fungemia. If the fungemia overwhelms the person's immune system, the fungus may spread to the CNS. The fungal invasion may cause meningitis, encephalitis, brain abscess, granuloma, or arterial thrombus (Fig. 52-5).

Clinical Manifestations

The common symptoms of fungal encephalitis include fever, malaise, headache, meningeal signs, and change in LOC or cranial nerve dysfunction. Symptoms of increased ICP related to hydrocephalus often occur. *C. neoformans* and *C. immitis* are associated with specific skin lesions. *H. capsulatum* is associated with seizures, and *A. fumigatus* may cause ischemic or hemorrhagic strokes.

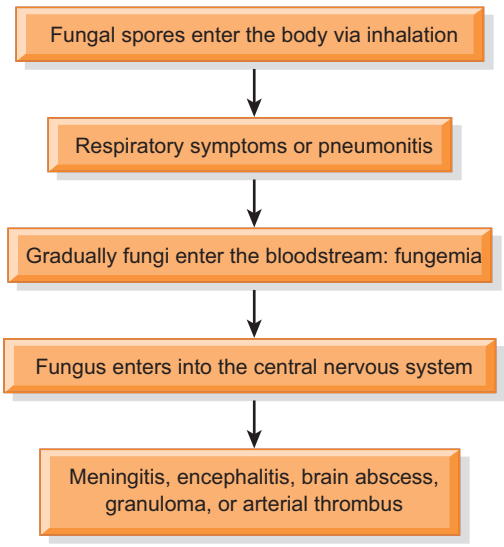


Figure 52-5 • Pathophysiology of fungal encephalitis.

Assessment and Diagnostic Findings

A history of immunosuppression associated with AIDS or the use of immunosuppressive medications may indicate fungal disease of the brain (Theroux, Phipps, Zimmerman, et al., 2013). Occupational and travel history may point to a fungal cause of CNS infection. Infections caused by *H. capsulatum* and *C. immitis* will demonstrate fungal antibodies in serologic tests. The CSF usually demonstrates elevated white cell and protein levels; glucose levels are decreased. *C. neoformans* is easily identified in CSF fungal cultures. *Candida* may be cultured from the blood or CSF. To identify *B. dermatitidis,* cisternal or ventricular cultures of CSF may need to be obtained. *A. fumigatus* is difficult to isolate in CSF and is diagnosed by lung biopsy. Neuroimaging is used to identify CNS changes related to fungal infection. MRI is the study of choice; it demonstrates areas of hemorrhage, abscess, or enhanced meninges indicating inflammation.

Medical Management

Medical management is directed at the causative fungus and the neurologic consequences of the infection. Seizures are controlled by standard anticonvulsant medications. Increased ICP is controlled by repeated lumbar punctures or shunting of CSF.

Antifungal agents are given for a specific period to cure the infection in patients with competent immune systems. Patients with compromised immune systems receive antifungal therapy until the infection is controlled, after which they receive a maintenance dose of the medication for an indefinite period. Amphotericin B is used for a progressive fungal infection that does not respond to conventional drug therapy. Dosing depends on the causative organism, and it is usually administered IV. Adverse reactions include fever, nausea and vomiting, anemia, uremia, and electrolyte abnormalities (especially potassium and magnesium). Toxicities may occur, and renal insufficiency is a serious reaction to amphotericin B that can occur (Comerford, 2015).

Fluconazole (Diflucan) or flucytosine (Ancobon) may be given orally in conjunction with amphotericin B as maintenance therapy. Potential side effects of fluconazole include nausea, vomiting, and a transient increase in liver enzymes. The most common adverse reaction to flucytosine is bone marrow depression (Comerford, 2015). Therefore, patients receiving flucytosine should have leukocyte and platelet counts monitored regularly.

Nursing Management

The ICP will increase if hydrocephalus develops and the inflammatory response progresses. Nursing assessment aimed at early identification of increased ICP is necessary to ensure early control and management. See Chapter 49 for management of the patient with increased ICP. Administering nonopioid analgesic agents, limiting environmental stimuli, and positioning may optimize patient comfort. Administering diphenhydramine (Benadryl) and acetaminophen/paracetamol (Tylenol) approximately 30 minutes before giving amphotericin B may prevent flulike side effects. If renal insufficiency develops, the dose may need to be reduced. Increasing levels of serum creatinine and blood urea nitrogen may alert the nurse to the development of renal insufficiency and the need to address the patient's renal status.

Providing support assists the patient and family to cope with the illness. Workup of the patient for immune deficiency diseases such as AIDS may put additional stress on the family. The nurse may need to mobilize community support systems for the patient and family, because the recovery may be long.

Neurocysticercosis

Neurocysticercosis is one of the common parasitic infections affecting the central nervous system. The larval form of pig tape worm (*Taeneia solium*) infests the central nerve system which is known as *neurocysticercosis*. Neurocysticercosis is the common cause of epilepsy in adults.

Epidemiology

It is highly endemic in countries where pig breeding is common and uncontrolled along with poor excreta hygiene and in countries where the immigration of people is high from Africa, Asia, and Latin America. An estimated 1 million cases are reported in India. In countries with low pork consumption, cysticercosis is uncommon (Jankovic, 2022).

Pathophysiology

Human beings are the definitive host of the pig tape worm. Pigs are the intermediate host. The *Taenia solium* gets itself hooked into the small intestine of the human being and passes hundreds of eggs along with excreta. When pigs eat the excreta containing the eggs, the eggs enter the pig gut and from there live larvae reach pork's blood and muscle tissues. When the pork flush infected with the live form of larvae called *cysticerci* is eaten in half cooked form the taenia cysticerci reach the various tissues of nervous system, eyes, and muscles. It may be a single cysticercus or multiple cysticerci growing together like a brain tumor. It may be calcified and remain quiet also. When it gets into meninges it may cause serious complications such as meningitis and encephalitis. The inflammatory reaction along with cysticerci may block the CSF circulation causing hydrocephalus.

It may affect the eyes leading to inflammation of the vitreous humor, uveitis, and endophthalmitis, progressive loss of visual acuity, and visual field loss.

In muscles, it may produce progressive weakness and enlargement of muscle (Del Brutto, 2012). The pathophysiology is depicted in Figure 52-6.

Clinical Manifestations

Symptom may start after 1–35 years of infestation. Atypical epilepsy is the most common manifestation. Other symptoms include the following:

- Headache
- Irritability
- Cognitive dysfunction
- Focal neurological deficit
- Rarely, signs of meningitis and hydrocephalus
- Occasionally, parkinsonian symptoms and psychiatric disturbances
- Loss of visual acuity and visual field loss
- Weakness and enlargement of involved muscles

Diagnosis

CT scan and MRI scan may show "hole-with-dot" appearance, diffuse brain edema, and cysticercus granuloma. Serological tests, e.g., enzyme-linked immunoblot test, will demonstrate antibody specific to *Taenia solium*.

Treatment

- Antihelminthic drugs such as albendazole, or praziquantel
- Anticonvulsant drugs

Control

- Hygienic disposal of human excreta
- Control of freely roaming pigs around human residential localities
- Hygienic slaughtering of pigs following veterinary standards

Creutzfeldt–Jakob and Variant Creutzfeldt–Jakob Diseases

CJD and vCJD belong to a group of degenerative, infectious neurologic disorders called *transmissible spongiform encephalopathies* (TSE). CJD is very rare and has no identifiable cause. vCJD, the human variation of bovine spongiform encephalopathy (BSE) (commonly known as mad cow disease), results from the ingestion by humans of prions in infected meat. TSEs are caused by prions, which are pathogens smaller than a virus that are resistant to standard methods of sterilization (National Institute of Neurological Disorders and Stroke [NINDS], 2016). Although CJD and vCJD have distinct clinical features, one characteristic they share is a lack of CNS inflammation. CJD may lie dormant for decades before causing neurologic degeneration. The incubation period of vCJD seems to be shorter (less than 10 years). In both diseases, the symptoms are progressive, there is no definitive treatment, and the outcome is fatal (Bader et al., 2016).

Almost all cases of vCJD have been reported in the United Kingdom, with a smaller number of cases being identified in 10 other countries worldwide. The risk of vCJD in the United States is thought to be low, because cattle are fed primarily with

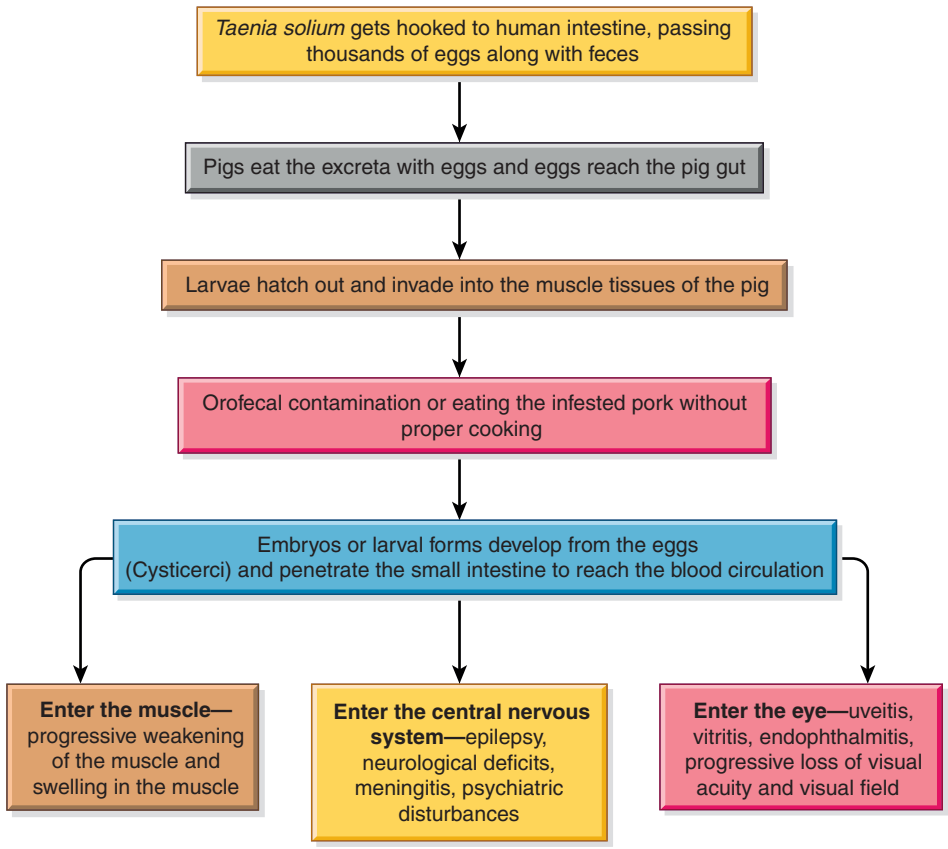


Figure 52-6 • Pathophysiology of neurocysticercosis.

soy-derived feed as opposed to feed containing animal parts (NINDS, 2016). CJD is not common in India and only 69 cases have been reported in NIMHANS during over 30 years period (Shankar & Chandra, 1997), 10 cases reported from Delhi, and 7 from Mumbai (Mehndiratta, Bajaj, Gupta, et al., 2001).

Pathophysiology

The prion is a unique pathogen because it lacks nucleic acid, which enables the organism to withstand conventional means of sterilization. It has not been isolated and it is believed to be a protein that takes on a different form (NINDS, 2016). In both CJD and vCJD, the prion crosses the blood–brain barrier and is deposited in brain tissue and causes degeneration of brain tissue. Cell death occurs, and spongiform changes (spongy vacuoles) are produced in the brain. The spongiform vacuoles are surrounded by amyloid plaque.

There are three major forms of CJD. Approximately 85% of cases of CJD appear sporadically; this form is called sporadic CJD. The incidence is one case per 1 million people. Sporadic CJD occurs spontaneously with no risk factors. The second form is familial or hereditary CJD, and this type accounts for 5% to 10% of cases (NINDS, 2016). The final type is acquired CJD. This form is transmitted by contaminated brain, tissue, or neurosurgical instruments and accounts for less than 1% of cases (Vacca, 2016).

The prion exists in lymphoid tissue and blood in both vCJD and CJD. Both prion diseases are believed to be blood-borne. No method is available to screen blood for infectivity. Pathophysiology of CJD/vCJD is presented in Figure 52-7.

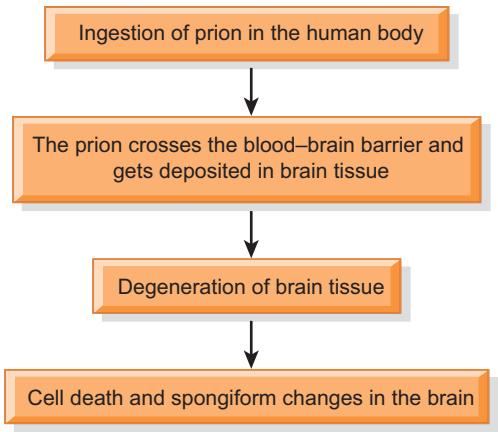


Figure 52-7 • Pathophysiology of Creutzfeldt–Jakob disease.

Clinical Manifestations

CJD and vCJD have several clinically distinct features. Psychiatric symptoms occur early in vCJD, whereas they are a late symptom in CJD. The mean age at onset of vCJD is 27 years, whereas the mean age for CJD onset is 65 years. The presenting symptoms of vCJD include affective symptoms (i.e., behavioral changes), sensory disturbance, and limb pain. Muscle spasms and rigidity, dysarthria, incoordination, cognitive impairment, and sleep disturbances follow. Patients with sporadic CJD present with mental deterioration, ataxia, and visual disturbance. Memory loss, involuntary movement, paralysis, and mutism occur as the disease progresses. After clinical presentation, people with

vCJD survive an average of 22 months; those with CJD survive for less than 1 year (Bader et al., 2016).

Assessment and Diagnostic Findings

Brain biopsy is not recommended to diagnose CJD. The three diagnostic tests currently used in suspicious clinical presentations to support the diagnosis of CJD are immunologic assessment, EEG, and MRI scanning. Immunologic assessment of CSF detects a protein kinase inhibitor referred to as 14–3–3. The presence of this inhibitor indicates neuronal cell death, which is not specific to CJD but does support the diagnosis. The EEG reveals a characteristic pattern over the duration of the disease. After initial slowing, the EEG shows periodic activity. Later in the course of the disease, the EEG shows burst suppressions characterized by periodic spikes alternating with slow periods. The MRI scan demonstrates symmetric or unilateral hyperintense signals arising from the basal ganglia (Bader et al., 2016).

Medical Management

After the onset of specific neurologic symptoms, progression of disease occurs quickly. There is no effective treatment for CJD or vCJD. The care of the patient is supportive and palliative. Goals of care include prevention of injury related to immobility and dementia, promotion of patient comfort, and provision of support and education for the family.

Nursing Management

The nursing care of patients is primarily supportive and palliative. Psychological and emotional support of the patient and family throughout the course of the illness is needed. Care extends to providing for a dignified death and supporting the family through the processes of grief and loss. Hospice services are appropriate either at home or at an inpatient facility. See Chapter 59 for an in-depth discussion of end-of-life issues.

Prevention of disease transmission is an important part of nursing care. Although patient isolation is not necessary, the use of standard precautions is important. Institutional protocols are followed for handling of brain, spinal cord, pituitary gland, and eye tissue; and for exposure and decontamination of equipment. In the operating room, it is recommended that disposable instruments be used and then incinerated, because conventional methods of sterilization do not destroy the prion (Bader et al., 2016). If disposable instruments cannot be used, stringent sterilization methods such as the use of bleach for cleaning and extended sterilization time for instruments should be used.

AUTOIMMUNE PROCESSES

Autoimmune nervous system disorders include multiple sclerosis (MS), myasthenia gravis, and Guillain–Barré syndrome (GBS).

Multiple Sclerosis

MS is an immune-mediated, progressive demyelinating disease of the CNS. Demyelination refers to the destruction of myelin—the fatty and protein material that surrounds certain nerve fibers in the brain and spinal cord; it results in impaired transmission of nerve impulses (see Fig. 52-8). MS may occur at any age,

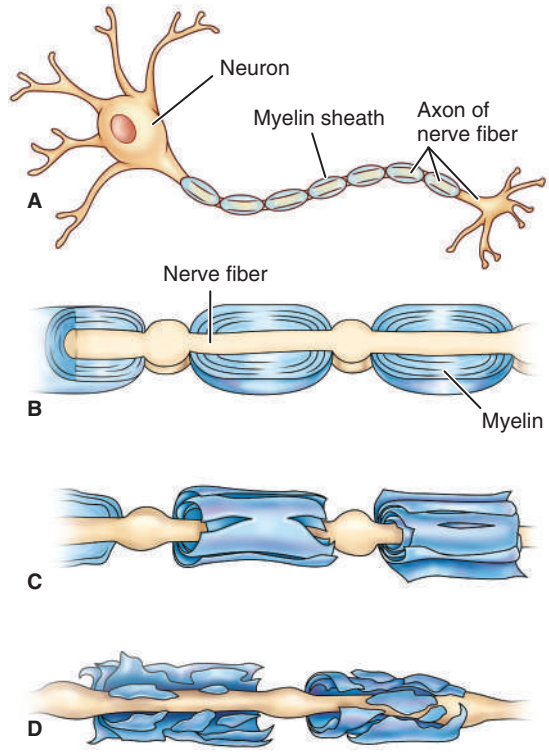


Figure 52-8 • The process of demyelination. **A**, **B**. A normal nerve cell and axon with myelin. **C**, **D**. The slow disintegration of myelin, resulting in a disruption in axon function.

but the age of peak onset is between 25 and 35 years; it affects women more frequently than men (Bader et al., 2016).

The cause of MS is an area of ongoing research. Autoimmune activity results in demyelination, but the sensitized antigen has not been identified. Multiple factors play a role in the initiation of the immune process. Geographic prevalence is highest in Europe, New Zealand, southern Australia, the northern United States, and southern Canada. MS is less prevalent in Asians. There is a North–South gradient, with greater frequency in temperate regions and latitudes away from the equator (Bader et al., 2016). The estimated prevalence rate of MS in India is 5 to 10 per 100,000 population; it may occur at any age but the peak onset is between 25–30 years and it affects women more frequently than men (Singhal, 2015).

MS is considered to have many risks, including genetic factors. However, it has not been found to be genetically transmitted (Bader et al., 2016). Genetic predisposition is indicated by the presence of a specific cluster (haplotype) of human leukocyte antigens on the cell wall. Its presence may increase susceptibility to factors, such as viruses, that trigger the autoimmune response activated in MS. A specific virus capable of initiating the autoimmune response has not been identified. It is believed that DNA on the virus mimics the amino acid sequence of myelin, resulting in an immune system cross-reaction in the presence of a defective immune system. Environmental risks include smoking, lack of vitamin D exposure, and exposure to the Epstein–Barr virus (Bader et al., 2016).

Pathophysiology

Sensitized T- and B lymphocytes cross the blood–brain barrier; their function is to check the CNS for antigens and then leave.

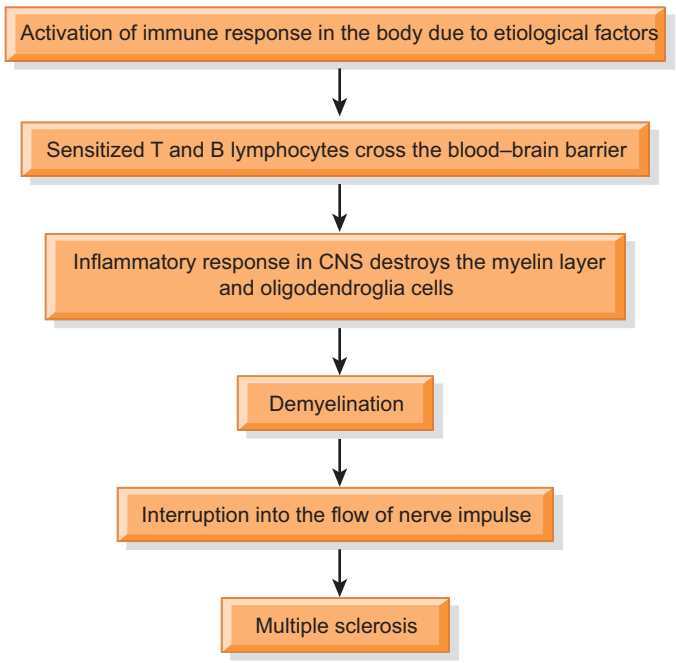


Figure 52-9 • Pathophysiology of multiple sclerosis.

In MS, sensitized T cells remain in the CNS and promote the infiltration of other agents that damage the immune system. The immune system attack leads to inflammation that destroys myelin (which insulates the axon and speeds the conduction of impulses along the axon) and the oligodendroglial cells that produce myelin in the CNS.

Demyelination interrupts the flow of nerve impulses and results in a variety of manifestations, depending on the nerves affected. Plaques appear on demyelinated axons, further interrupting the transmission of impulses. Demyelinated axons are scattered irregularly throughout the CNS. The areas most frequently affected are the optic nerves, chiasm, and tracts; the cerebrum; the brainstem and cerebellum; and the spinal cord. The axons themselves begin to degenerate, resulting in permanent and irreversible damage (Wu & Alvarez, 2016). Pathophysiology of MS is presented in Figure 52-9.

Clinical Manifestations

The course of MS may assume many different patterns (Lublin & Reingold, 1996) (see Fig. 52-10). In some patients, the disease follows a benign course, and symptoms are so mild that the patient does not seek health care or treatment. Approximately 85% of patients with MS have a *relapsing-remitting* (RR) course. With each relapse, recovery is usually complete; however, residual deficits may occur and accumulate over time, contributing to functional decline. Over time, most patients with the RR course of MS progress to a *secondary progressive* course, in which disease progression occurs with or without relapses. Approximately 15% of patients have a *primary progressive* course, in which disabling symptoms steadily increase, with rare plateaus and temporary minor improvement. Primary progressive MS may result in quadriparesis, cognitive dysfunction, visual loss, and brainstem syndromes. The least common presentation (about 5% of cases) is the *progressive-relapsing* course. It is characterized by relapses with continuous disabling progression between exacerbations (Hickey, 2014).

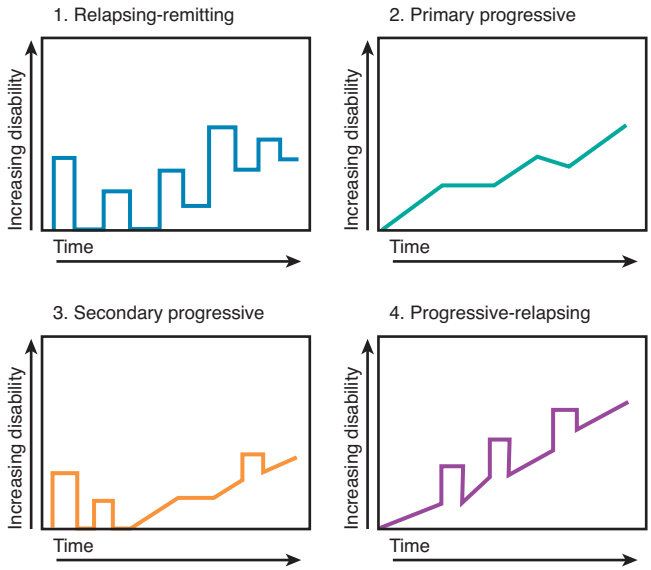


Figure 52-10 • Types and courses of multiple sclerosis (MS). **1**. Relapsing-remitting (RR) MS is characterized by clearly acute attacks with full recovery or with sequelae and residual deficit upon recovery. Periods between disease relapses are characterized by lack of disease progression. **2**. Primary progressive MS is characterized by disease showing progression of disability from onset, without plateaus and temporary minor improvements. **3**. Secondary progressive MS begins with an initial RR course, followed by progression of variable rate, which may also include occasional relapses and minor remissions. **4**. Progressive-relapsing MS shows progression from onset but with clear acute relapses with or without recovery. From Lublin, F. D., & Reingold, S. C. (1996). Defining the clinical course of multiple sclerosis: Results of an international survey. Neurology, 46(64), 907–911. Used with permission from Lippincott Williams & Wilkins.

The signs and symptoms of MS are varied and multiple, reflecting the location of the lesion (plaque) or combination of lesions. The main symptoms most commonly reported are fatigue, depression, weakness, numbness, difficulty in coordination, loss of balance, spasticity, and pain (Bader et al., 2016). Visual disturbances due to lesions in the optic nerves or their connections may include blurring of vision, diplopia (double vision), scotoma (patchy blindness), and total blindness.

Fatigue affects most people with MS and is often the most disabling symptom (Riley & Vargus, 2015); (Morrison & Stuifbergen, 2016). Heat, depression, anemia, deconditioning, and medication may contribute to fatigue. Avoiding hot temperatures, effective treatment of depression and anemia, a change in medication as well as occupational and physical therapies may help manage fatigue.

Pain is another common symptom of MS that can contribute to social isolation. Lesions on the sensory pathways cause pain. Additional sensory manifestations include paresthesias, dysesthesias, and proprioception loss. Many people with MS need daily analgesic medications. In some cases, pain is managed with opioids, anticonvulsant medications, or antidepressants. Rarely, surgery may be needed to interrupt pain pathways.

Among women who are perimenopausal, those with MS are more likely to have pain related to osteoporosis. In addition to estrogen loss, immobility and corticosteroid therapy play a role in the development of osteoporosis among women with MS. Bone mineral density testing is recommended for this high-risk group. See Chapter 37 for a discussion of the diagnosis of and treatment for osteoporosis.

Spasticity (muscle hypertonicity) occurs in 90% of patients with MS, most often in the lower extremities, and can include loss of the abdominal reflexes. Spasticity results from involvement of the main motor pathways (pyramidal tracts) of the spinal cord. Cognitive and psychosocial problems may reflect frontal or parietal lobe involvement. Some degree of cognitive change (e.g., memory loss, decreased concentration) occurs in about half of patients, but severe cognitive changes with dementia (progressive organic mental disorder) are rare.

Involvement of the cerebellum or basal ganglia can produce ataxia (impaired coordination of movements) and tremor. Loss of the control connections between the cortex and the basal ganglia may occur and cause emotional lability and euphoria. Bladder, bowel, and sexual dysfunctions are common.

Researchers reported that patients with MS have higher rates of depression, arthritis, diabetes, coronary artery disease, migraine headaches, and cancer compared to a normative population (Newland, Jensen, Budhathoki, et al., 2015). Additional complications include urinary tract infections, constipation, pressure ulcers, contracture deformities, dependent pedal edema, pneumonia, and osteoporosis. Emotional, social, marital, economic, and vocational problems may also occur.

Exacerbations and remissions are characteristic of MS. During exacerbations, new symptoms appear and existing ones worsen; during remissions, symptoms decrease or disappear. Relapses may be associated with emotional and physical stress.

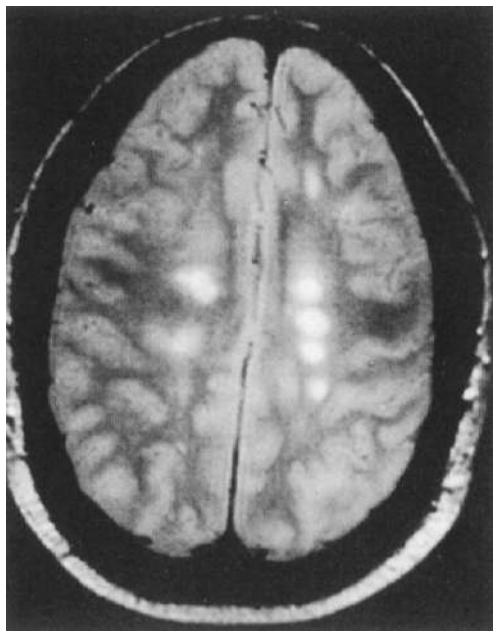


Figure 52-11 • Multiple sclerosis. Axial T-2 weighted image shows ovoid hyperintense lesions in both hemispheres. From Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Gerontologic Considerations

The life expectancy for patients with MS is 5 to 7 years shorter than patients without MS (Bader et al., 2016). Those diagnosed with secondary progressive disease live an average of 38 years after onset. Older adult patients with MS have specific physical and psychosocial challenges. They may have chronic health problems, for which they may be taking additional medications that could interact with medications prescribed for MS. The absorption, distribution, metabolism, and excretion of medications are altered in the older adult as a result of age-related changes in kidney and liver functions. Therefore, older adult patients must be monitored closely for adverse and toxic effects of MS medications and for osteoporosis (particularly if corticosteroids have been used frequently to treat exacerbations). The cost of medications may lead to poor adherence to the prescribed regimen in older adult patients on fixed incomes.

Older adult patients with MS are particularly concerned about increasing disability, family burden, marital concern, and the possible future need for nursing home care. Immobility resulting in fewer social opportunities contributes to loneliness and depression. Researchers found that 58% of older adults with MS reported frequent depressed feelings and more than 30% contemplated suicide (Buhse, 2015). In addition to functional loss, the physical challenges experienced by older adults with MS include spasticity, pain, bladder dysfunction, impaired sleep, and an increased need for assistance with self-care.

Assessment and Diagnostic Findings

The diagnosis of MS is based on the presence of multiple plaques in the CNS observed with MRI (Hickey, 2014) (see Fig. 52-11). Additional studies augment the diagnosis. Electrophoresis of CSF identifies the presence of oligoclonal banding (several bands of immunoglobulin G bonded together, indicating an immune system abnormality). Evoked potential studies can help define the extent of the disease process and monitor changes. Underlying bladder dysfunction is diagnosed by urodynamic studies. Neuropsychological testing may be indicated to assess cognitive impairment. A sexual history helps identify changes in sexual function.

Medical Management

No cure exists for MS. An individual treatment program is indicated to relieve the patient's symptoms and provide continuing support, particularly for patients with cognitive changes, who may need more structure and support. The goals of treatment are to delay the progression of the disease, manage chronic symptoms, and treat acute exacerbations. Common symptoms requiring intervention include ataxia, bladder dysfunction, depression, fatigue, and spasticity. Management includes pharmacologic and nonpharmacologic strategies.

Pharmacologic Therapy

Medications prescribed for MS include those for disease modification and those for symptom management. Disease-modifying therapies are available to treat some of the different forms of MS (Hickey, 2014). Many types of medications are used for symptom management in MS.

Disease-Modifying Therapies

The disease-modifying medications reduce the frequency of relapse, the duration of relapse, and the number and size of plaques observed on MRI in the RR form of MS, but are not effective in the primary progressive type of MS (Hickey, 2014).

Interferon beta-1a (Rebif) and interferon beta-1b (Betaseron) may be given subcutaneously every other day. Another preparation of interferon beta-1a (Avonex) may be given intramuscularly once a week. Side effects of all interferon-beta medications include flulike symptoms in approximately half of

patients taking these drugs that cause patients to discontinue therapy (Filipi, Beavin, Brillante, et al., 2014). For optimal control of disability, disease-modifying medications should be started early in the course of the disease (Comerford, 2015).

Glatiramer acetate (Copaxone) also reduces the rate of relapse in the RR course of MS. Copaxone is given subcutaneously daily (Hickey, 2014). Copaxone is an option for those with an RR course; however, it may take 6 months for evidence of an immune response to appear. There are oral disease-modifying agents that also reduce disease activity and disease progression. Teriflunomide (Aubagio), fingolimod (Gilenya), and dimethyl fumarate (Tecfidera) are oral alternatives that may be better tolerated by the patient who have difficulty with injection reactions (Hickey, 2014).

IV methylprednisolone, the key agent in treating acute relapse in the RR course, shortens the duration of relapse but has not been found to have long-term benefit (Bader et al., 2016). It exerts anti-inflammatory effects by acting on T cells and cytokines. The medication is given as 1 g IV daily for 3 to 5 days, followed by an oral taper of prednisone. Side effects include mood swings, weight gain, and electrolyte imbalances (Comerford, 2015).

The medication mitoxantrone (Novantrone) is given via IV infusion every 3 months. Mitoxantrone can reduce the frequency of clinical relapses in patients with secondary progressive or worsening RR MS. Patients must be very closely monitored for side effects (i.e., cardiac toxicity), and there is a maximum lifetime dose that can be given (Hickey, 2014).

Symptom Management

Medications are also prescribed for management of specific symptoms. Baclofen (Lioresal), a gamma-aminobutyric acid agonist, is the medication of choice for treating spasticity. It can be given orally or by intrathecal injection for severe spasticity. Benzodiazepines (e.g., diazepam [Valium]), tizanidine (Zanaflex), and dantrolene (Dantrium) may also be used to treat spasticity (Hickey, 2014). Patients with disabling spasms and contractures may require nerve blocks or surgical intervention. Fatigue that interferes with activities of daily living (ADLs) may be treated with amantadine (Symmetrel), pemoline (Cylert), or dalfampridine (Ampyra). Ataxia is a chronic problem most resistant to treatment. Medications used to treat ataxia include beta-adrenergic blockers (e.g., propranolol [Inderal]), the anticonvulsant agent gabapentin (Neurontin), and benzodiazepines (e.g., clonazepam [Klonopin]).

Bladder and bowel problems are often difficult for patients, and a variety of medications (anticholinergic agents, alpha-adrenergic blockers, antispasmodic agents) may be prescribed. Nonpharmacologic strategies also assist in establishing effective bowel and bladder elimination (see later discussion).

Urinary tract infection may be superimposed on the underlying neurologic dysfunction. Ascorbic acid (vitamin C) may be prescribed to acidify the urine, making bacterial growth less likely. Antibiotic agents are prescribed when appropriate.

NURSING PROCESS

The Patient with MS

Assessment

Nursing assessment addresses neurologic deficits, secondary complications, and the impact of the disease on the patient and family. The patient's mobility and balance are observed to determine whether there is risk of falling. Assessment of function is carried out both when the patient is well rested and when fatigued. The patient is assessed for weakness, spasticity, visual impairment, incontinence, and disorders of swallowing and speech. Additional areas of assessment include how MS has affected the patient's lifestyle, how the patient is coping, adherence to the prescribed medication regimen, and what the patient would like to improve.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Impaired bed and physical mobility related to weakness, muscle paresis, spasticity, increased weight
- Risk for injury related to sensory and visual impairment
- Impaired urinary elimination (urgency, frequency, incontinence), constipation, and bowel incontinence related to nervous system dysfunction
- Impaired verbal communication and risk for aspiration related to cranial nerve involvement
- Chronic confusion related to cerebral dysfunction
- Ineffective coping related to uncertainty of course of MS
- Impaired home maintenance management related to physical, psychological, and social limits imposed by MS
- Ineffective sexuality pattern related to lesions or psychological reaction

Planning and Goals

The major goals for the patient may include promotion of physical mobility, avoidance of injury, achievement of bladder and bowel continence, promotion of speech and swallowing mechanisms, improvement of cognitive function, development of coping strengths, improved home maintenance management, and adaptation to sexual dysfunction.

Nursing Interventions

An individualized program of physical, occupational, and speech-language therapy, rehabilitation, and education is combined with emotional support. An educational plan of care is developed to enable the person with MS to deal with the physiologic, social, and psychological problems that accompany chronic disease. The presence of depression, pain, fatigue, and walking difficulty all decrease physical activity. Assisting patients with management of these symptoms may help increase the level of physical activity and overall sense of well-being.

Promoting Physical Mobility

Relaxation and coordination exercises promote muscle efficiency. Progressive resistive exercises are used to strengthen weak muscles, because diminishing muscle strength is often significant in MS.

Exercises. Walking improves the gait, particularly the problem of loss of position sense of the legs and feet. If certain muscle groups are irreversibly affected, other muscles can be trained to compensate. Instruction in the use of assistive devices may be needed to ensure their safe and correct use.

Minimizing Spasticity and Contractures. Muscle spasticity is common and, in its later stages, is characterized by severe adductor spasm of the hips with flexor spasm of the hips and knees. Without relief, fibrous contractures of these joints occur. Warm packs may be beneficial, but hot baths should be avoided because of risk of burn injury secondary to sensory loss and

increasing symptoms that may occur with elevation of the body temperature.

Daily exercises for muscle stretching are prescribed to minimize joint contractures. Special attention is given to the hamstrings, gastrocnemius muscles, hip adductors, biceps, and wrist and finger flexors. Muscle spasticity is common and interferes with usual function. Application of prescribed orthotics may help maintain a functional position and reduce contractures. A stretch–hold–relax routine is helpful for relaxing and treating muscle spasticity. Swimming and stationary bicycling are useful, and progressive weight bearing can relieve spasticity in the legs. The patient should not be hurried in any of these activities, because this often increases spasticity.

Activity and Rest. The patient is encouraged to work and exercise to a point just short of fatigue. Very strenuous physical exercise is not advisable, because it raises the body temperature and may aggravate symptoms. The patient is advised to take frequent short rest periods, preferably lying down. Extreme fatigue may contribute to the exacerbation of symptoms. One study reported that functional limitations and depressive symptoms were the strongest predictors of fatigue impact in patients with long-standing MS (see Chart 52-3) (Morrison & Stuifbergen, 2016).

Nutrition. Similar to the population at large, many patients with MS are overweight or have obesity. Contributing factors include the use of corticosteroids for exacerbations of symptoms and mobility impairments as a result of the disease. Interventions to promote healthy eating and weight reduction need to take into account that fatigue and mobility impairments are barriers to engagement in nutritional behaviors for people with MS. Nurses also need to be certain to include family members in interventions and nutrition education, because they are often the gatekeepers for food preparation and selection. Additional strategies include avoidance of alcohol and cigarette smoking (Bader et al., 2016).

Minimizing Effects of Immobility. Because of the decrease in physical activity that often occurs with MS, complications associated with immobility, including pressure ulcers, expiratory muscle weakness, and accumulation of bronchial secretions, need to be considered and steps taken to prevent them. Measures to prevent such complications include assessing and maintaining skin integrity and having the patient perform coughing and deep-breathing exercises.

Preventing Injury

If motor dysfunction causes problems of incoordination and clumsiness, or if ataxia is apparent, then the patient is at risk for falling. To overcome this disability, the patient is instructed to walk with feet apart to widen the base of support and to increase walking stability. If loss of position sense occurs, the patient is instructed to watch the feet while walking. Gait training may require assistive devices (walker, cane, braces, crutches, parallel bars) and instruction about their use by a physiotherapist. If the gait remains inefficient, a wheelchair or motorized scooter may be the solution. The occupational therapist is a valuable resource person in suggesting and securing aids to promote independence. If incoordination is a problem and tremor of the upper extremities occurs when voluntary movement is attempted (intention tremor), weighted bracelets or wrist cuffs are helpful. The patient is trained in transfer and ADLs.

Because sensory loss may occur in addition to motor loss, pressure ulcers are a continuing threat to skin integrity. The need to use a wheelchair continuously increases the risk. See Chapter 51 for a discussion of the prevention and treatment of pressure ulcers.

Enhancing Bladder and Bowel Control

In general, bladder symptoms fall into the following categories: (1) inability to store urine (hyperreflexic, uninhibited); (2) inability to empty the bladder (hyporeflexic, hypotonic); and (3) a mixture of both types. The patient with urinary frequency, urgency, or incontinence requires special support. The sensation of the need to void must be heeded immediately, so the bedpan or urinal should be readily available. A voiding time schedule is set up (every 1.5 to 2 hours initially, with gradual lengthening of the interval). The patient is instructed

Chart 52-3 NURSING RESEARCH PROFILE

Predictors of Fatigue in Patients with MS

Morrison, J. D., & Stuifbergen, A. K. (2016). Predictors of fatigue impact in persons with long-standing multiple sclerosis. Journal of Neuroscience Nursing, 48(3), 143–150.

Purpose

Fatigue is very common among those with MS and has a negative impact on many aspects of their lives. The underlying mechanisms are poorly understood and treatment is a challenge. The purpose of this study was to explain the physical, cognitive, and psychosocial dimensions of fatigue among those with long-standing MS.

Design

More than 300 people with long-standing MS (for 17 years or more) were surveyed to measure fatigue impact, MS related functional limitations, depressive symptoms, barriers to health promotion, personal resources, and health promoting behaviors. The relationships among fatigue impact, age, MS duration, MS related functional limitations, depressive symptoms, barriers to health promotion, personal resources, and health promoting behaviors were also explored.

Findings

Age and MS duration were not significantly related to fatigue impact. Moderate to strong positive, linear relationships were reported among fatigue impact measures and MS functional limitations (range: $r = 0.41–0.58$, $p < 0.01$), depressive symptoms (range: $r = 0.58–0.63$, $p < 0.01$), and barriers (range: $r = 0.55–0.63$, $p < 0.01$). Moderate inverse linear relationships were reported among fatigue impact measures and personal resources (range: $r = –0.40–0.50$, $p < 0.01$) and health-promoting behaviors (range: $r = –0.34–0.44$, $p < 0.01$). MS functional limitation was reported as the strongest predictor of physical and psychosocial fatigue impact, while depressive symptoms was the strongest predictor of total and cognitive fatigue impact.

Nursing Implications

Nurses working with patients with MS should know that functional limitations and depressive symptoms were strong predictors of fatigue impact in this study. This illustrates the importance of nurses assessing and monitoring depressive symptoms, functional status, and dimensions of fatigue at each encounter with patients, whether in the in-patient or out-patient setting.

to drink a measured amount of fluid every 2 hours and then attempt to void 30 minutes after drinking. The use of a timer or wristwatch with an alarm may be helpful for the patient who does not have enough sensation to signal the need to empty the bladder. The nurse encourages the patient to take the prescribed medications to treat bladder spasticity, because this allows greater independence. Intermittent self-catheterization (see Chapter 51) has been successful in maintaining bladder control in patients with MS. If a female patient has permanent urinary incontinence, urinary diversion procedures may be considered. The male patient may wear a condom appliance for urine collection.

Bowel problems include constipation, fecal impaction, and incontinence. Adequate fluids, dietary fiber, and a bowel training program are frequently effective in solving these problems. See Chapter 51 for a discussion of promoting bowel continence.

Enhancing Communication and Managing Swallowing Difficulties

If the cranial nerves that control the mechanisms of speech and swallowing are affected, dysarthrias (defects of articulation) marked by slurring, low volume of speech, and difficulties in phonation may occur. Dysphagia (difficulty swallowing) may also occur. A speech-language pathologist evaluates speech and swallowing and instructs the patient, family, and health team members about strategies to compensate for speech and swallowing problems. The nurse reinforces this instruction and encourages the patient and family to adhere to the plan.

Nursing Alert: Impaired swallowing increases the patient's risk of aspiration. To reduce that risk, the nurse implements strategies such as having suction apparatus available, ensuring careful feeding, confirming correct food and liquid consistency, and positioning properly for eating.

Improving Cognitive Function

Measures may be taken if visual defects or changes in cognitive status occur and result in chronic confusion.

Vision. The cranial nerves affecting vision may be affected by MS. An eye patch or a covered eyeglass lens may be used to block the visual impulses of one eye if the patient has diplopia. Prism glasses may be helpful for patients who are confined to bed and have difficulty reading in the supine position.

Cognition and Emotional Responses. Cognitive impairment and emotional lability occur early in MS in some patients and may impose numerous stresses on the patient and family. Some patients with MS are forgetful and easily distracted and may exhibit emotional lability.

Patients adapt to illness in a variety of ways, including denial, depression, withdrawal, and hostility. Emotional support assists patients and their families to adapt to the changes and uncertainties associated with MS and to cope with the disruption in their lives. The family should be made aware of the nature and degree of cognitive impairment. Patients with MS have identified that the support of family and friends is a major need. The patient is assisted to set meaningful and realistic goals, to remain as active as possible, and to maintain interests and activities. Hobbies may help the patient's morale and provide satisfying interests if the disease progresses to the stage in which formerly enjoyed activities can no longer be pursued. The environment is kept structured, distractions are reduced, and lists and other memory aids are used to help the patient with cognitive changes maintain a daily routine. The occupational therapist can be helpful in formulating a structured daily routine.

Strengthening Coping Mechanisms

The diagnosis of MS is always distressing to the patient and family. They need to know that no two patients with MS have identical symptoms or courses of illness. Although some patients do experience significant disability early, others have a near-normal lifespan with minimal disability. Some families, however, face acute frustrations and problems. MS affects people who are often in an early stage of life and concerned about career and family responsibilities. Family conflict, disintegration, separation, and divorce are not uncommon. Often, very young family members assume the responsibility of caring for a parent with MS. Nursing interventions in this area include assisting patients and families to manage or reduce stress and making appropriate referrals for counseling and support to minimize the adverse effects of dealing with chronic illness.

The nurse, mindful of these complex problems, initiates home care and coordinates a network of services, including social services, speech therapy, physical therapy, and homemaker services. To strengthen the patient's coping skills, as much information as possible is provided. Patients need an updated list of available assistive devices, services, and resources.

Coping through problem solving involves helping the patient define the problem and develop alternatives for its management. Planning carefully, maintaining flexibility, and preserving a hopeful attitude are useful for psychological and physical adaptation.

Improving Home Management

MS can affect every facet of daily living. Certain abilities are often impossible to regain after they are lost. Physical function may vary from day to day. Modifications that allow independence in home management should be implemented (e.g., assistive eating devices, raised toilet seat, bathing aids, telephone modifications, long-handled comb, tongs, modified clothing). Exposure to heat increases fatigue and muscle weakness, so air conditioning is recommended in at least one room. Exposure to extreme cold may increase spasticity.

Promoting Sexual Functioning

Patients with MS and their partners face problems that interfere with sexual activity, both as a direct consequence of nerve damage and also from psychological reactions to the disease. Easy fatigability, conflicts arising from dependency and depression, emotional lability, and loss of self-esteem compound the problem. Erectile and ejaculatory disorders in men and orgasmic dysfunction and adductor spasms of the thigh muscles in women can make sexual intercourse difficult or impossible. Bladder and bowel incontinence and urinary tract infections add to the difficulties.

Collaboration between the patient, family, and primary provider is essential for supporting intimacy. A sexual counselor can help bring into focus the patient's or partner's sexual resources and suggest relevant information and supportive therapy. Sharing and communicating feelings, planning for sexual activity (to minimize the effects of fatigue), and exploring alternative methods of sexual expression may open up a wide range of sexual enjoyment and experiences.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. As the disease progresses, the patient and family need to learn new strategies to maintain optimal independence. Educating about self-care techniques may be initiated in the hospital or clinic setting and reinforced in the home. Self-care education may address the use of assistive devices, self-catheterization, and administration of medications that affect the course of the disease or treat complications. An education plan that addresses intramuscular or subcutaneous administration of medications (including side effects) is developed for the patient and their family or caregiver. A panel of experts concluded that flulike symptoms resulting from injectable disease-modifying drugs can be mitigated by dose titration, use of analgesics, evening dosing, drug formulation, solution temperature, adequate hydration, and a nutritious diet (Filipi et al., 2014). The patient and family are educated about exercises that enable the patient to continue some form of activity or that maintain or improve swallowing, speech, or respiratory function (see Chart 52-4).

Continuing and Transitional Care. After discharge, the nurse often provides education and reinforcement of new interventions in the patient's home. Nurses in the home setting assess for changes in the patient's physical and emotional status; provide physical care to the patient if required; coordinate outpatient services and resources; and encourage health promotion, appropriate health screenings, and adaptation. If changes in the disease or its course are noted, the nurse encourages the patient to contact the primary provider, because treatment of an acute exacerbation or new problem may be indicated. Continuing health care and follow-up are recommended.

Evaluation

Expected patient outcomes may include:

1. Improves physical mobility
   a. Participates in gait training and rehabilitation program
   b. Establishes a balanced program of rest and exercise
   c. Uses assistive devices correctly and safely
2. Is free of injury
   a. Uses visual cues to compensate for decreased sense of touch or position
   b. Asks for assistance when necessary
3. Attains or maintains control of bladder and bowel patterns
   a. Monitors self for urine retention and employs intermittent self-catheterization technique, if indicated
   b. Identifies the signs and symptoms of urinary tract infection
   c. Maintains adequate fluid and fiber intake
   d. Identifies the foods that are constipating versus food that increase gastric motility
4. Participates in strategies to improve speech and swallowing
   a. Practices exercises recommended by speech therapist
   b. Maintains adequate nutritional intake without aspiration
5. Compensates for chronic confusion
   a. Uses lists and other aids to compensate for memory losses
   b. Discusses problems with trusted advisor or friend
   c. Substitutes new activities for those that are no longer possible
6. Demonstrates effective coping strategies
   a. Maintains sense of control
   b. Modifies lifestyle to fit goals and limitations
   c. Verbalizes desire to pursue goals and developmental tasks of adulthood
   d. Demonstrates healthy social interactions
   e. Participates in groups or community activities
7. Adheres to plan for home maintenance management
   a. Uses appropriate techniques to maintain independence
   b. Engages in health-promotion activities and health screenings as appropriate
8. Adapts to changes in sexual function
   a. Is able to discuss problem with partner and appropriate health professional
   b. Identifies alternative means of sexual expression

Chart 52-4 HOME CARE CHECKLIST

The Patient with MS

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of MS and treatment on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State the purpose, dose, route, schedule, side effects, and precautions for prescribed medications.
  - Demonstrate correct techniques of administering injectable medications, if prescribed.
- State how to contact all members of the treatment team (e.g., health care providers, home care professionals, and durable medical equipment and supply vendor).
- State changes in lifestyle (e.g., exercise, activity) necessary to maintain health.
  - Demonstrate environmental modifications and adaptive techniques for accomplishing activities of daily living.
  - Identify strategies to manage symptoms (pain, cognitive responses, dysphagia, tremors, visual disturbances).
  - State how to prevent complications (e.g., pressure ulcers, pneumonia, depression).
  - Identify coping strategies.
  - Identify ways to minimize fatigue.
  - Explain how to prevent injury.
  - Identify optimal nutritional intake; consider weight reduction as indicated if patient is overweight or has obesity.
  - State ways to promote sexual function.
  - Discuss ways to manage bowel and bladder function.
  - Name benefits of exercise and physical activity.
  - Identify ways to minimize immobility and spasticity.
- Relate how to reach primary provider with questions or complications.
- State time and date of follow-up medical appointments, therapy, and testing.
- Identify sources of support (e.g., friends, relatives, caregiver support).
- Identify the need for health promotion, disease prevention, and screening activities.

ADL, activities of daily living; IADL, independent activities of daily living; MS, multiple sclerosis.

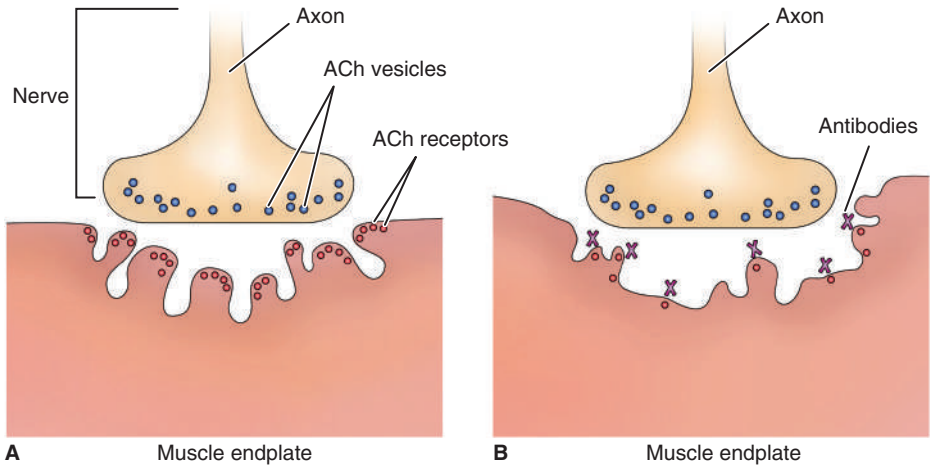


Figure 52-12 • Myasthenia gravis. **A.** Usual acetylcholine (ACh) receptor site. **B.** ACh receptor site in myasthenia gravis.

Myasthenia Gravis

Myasthenia gravis, an autoimmune disorder affecting the myoneural junction, is characterized by varying degrees of weakness of the voluntary muscles. More women than men are affected, commonly in the second and third decades of life; however, after age 50, the gender distribution is more equal (American Association of Neuroscience Nurses [AANN], 2013); (Bader et al., 2016).

Unlike in western countries, men are affected more than women in India (ratio is 2.70:1). Onset of this condition among men is common in the fifth to sixth decades, whereas women experience early onset of the condition, i.e., commonly in third decades of life (Singhal, Bhatia, & Umesh, 2008).

Pathophysiology

Normally, a chemical impulse precipitates the release of acetylcholine from vesicles on the nerve terminal at the myoneural junction. The acetylcholine attaches to receptor sites on the motor endplate and stimulates muscle contraction. Continuous binding of acetylcholine to the receptor site is required for muscular contraction to be sustained.

In myasthenia gravis, antibodies directed at the acetylcholine receptor sites impair transmission of impulses across the myoneural junction. Therefore, fewer receptors are available for stimulation, resulting in voluntary muscle weakness that escalates with continued activity (see Fig. 52-12). These antibodies are found in 80% to 90% of people with myasthenia gravis (Hickey, 2014). Of people with myasthenia gravis, 75% have either thymic hyperplasia or a thymic tumor, and the thymus gland is believed to be the site of antibody production (Bader et al., 2016). In patients who are antibody negative, researchers believe that the offending antibody is directed at a portion of the receptor site rather than the whole complex (AANN, 2013). Pathophysiology of myasthenia gravis is presented in Figure 52-13.

Clinical Manifestations

The initial manifestation of myasthenia gravis in 80% of patients involves the ocular muscles. Diplopia and ptosis (drooping of the eyelids) are common (Bader et al., 2016). Many patients also experience weakness of the muscles of the face and throat (bulbar symptoms) and generalized weakness. Weakness of the facial muscles results in a bland facial expression. Laryngeal involvement produces dysphonia (voice impairment) and dysphagia, which increases the risk of choking and aspiration. Generalized weakness affects all extremities and the intercostal muscles, resulting in decreasing vital capacity and respiratory failure (Mcilvoy, 2014). Myasthenia gravis is purely a motor disorder with no effect on sensation or coordination.

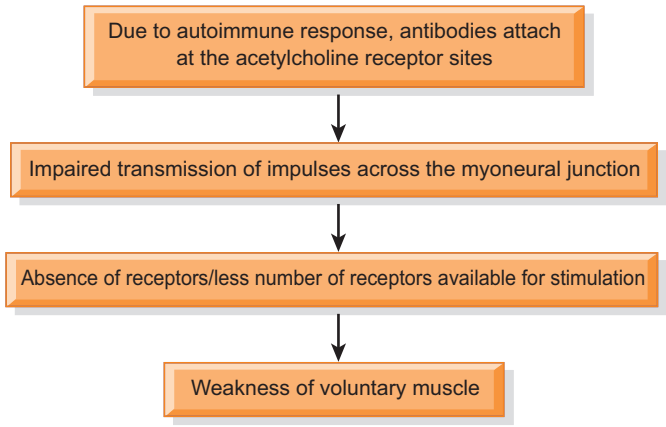


Figure 52-13 • Pathophysiology of myasthenia gravis.

Assessment and Diagnostic Findings

A common test used to diagnose myasthenia gravis is the acetylcholinesterase inhibitor test. It is performed by administering edrophonium chloride (Tensilon) IV; 30 seconds after injection, facial muscle weakness and ptosis should resolve for about 5 minutes (Hickey, 2014). Immediate improvement in muscle strength after administration of this agent represents a positive test and usually confirms the diagnosis. Atropine should be available to control potential side effects of this medication, which include bradycardia, asystole, bronchoconstriction, sweating, and cramping.

Another study, the ice test, is indicated in patients who have cardiac conditions or asthma. With this test, an ice pack is held over the patient's eyes for 1 minute; the ptosis should temporarily resolve in a patient with myasthenia gravis (Hickey, 2014).

Several blood tests for acetylcholine antibodies are also used to confirm the diagnosis (AANN, 2013). Repetitive nerve

stimulation (RNS) demonstrates a decrease in successive action potentials. A single-fiber electromyography (EMG) detects a delay or failure of neuromuscular transmission and is about 99% sensitive in confirming the diagnosis of myasthenia gravis (Hickey, 2014). This is an uncomfortable test for the patient.

The thymus gland, a site of acetylcholine receptor antibody production, may be enlarged in myasthenia gravis and may be identified by MRI scan.

Medical Management

Management of myasthenia gravis is directed at improving function and reducing and removing circulating antibodies. Therapeutic modalities include administration of anticholinesterase medications and immunosuppressive therapy, intravenous immune globulin (IVIG), therapeutic plasma exchange (TPE), and thymectomy. There is no cure for myasthenia gravis; treatments do not stop the production of the acetylcholine receptor antibodies.

Pharmacologic Therapy

Pyridostigmine bromide (Mestinon), an anticholinesterase medication, is the first line of therapy (Mcilvoy, 2014). It provides symptomatic relief by inhibiting the breakdown of acetylcholine and increasing the relative concentration of available acetylcholine at the neuromuscular junction. The dosage is gradually increased to a daily maximum and is given in divided doses (usually four times a day). Adverse effects of anticholinesterase medications include diarrhea, abdominal cramps, and/or excessive saliva (Comerford, 2015). Pyridostigmine tends to have fewer side effects than other anticholinesterase medications.

If pyridostigmine bromide does not improve muscle strength and control fatigue, the next agents used are the immunomodulating drugs. The goal of immunosuppressive therapy is to reduce production of the antibody. Corticosteroids suppress the patient's immune response, decreasing the amount of antibody production, and this correlates with clinical improvement. An initial dose of prednisone is given daily and maintained for 1 to 2 months; as symptoms improve, the medication is tapered (Bader et al., 2016). As the corticosteroid medications take effect, the dosage of anticholinesterase medication can usually be lowered. Cytotoxic medications are used to treat myasthenia gravis if there is inadequate response to steroids. Azathioprine (Imuran) inhibits T lymphocytes and B-cell proliferation and reduces acetylcholine receptor antibody levels. Therapeutic effects may not be evident for 3 to 12 months. Leukopenia and hepatotoxicity are serious adverse effects, so monthly evaluation of liver enzymes and white blood cell count is necessary.

Intravenous immune globulin (IVIG) can be used to treat exacerbations; however, in selected patients, it is used on a long-term adjunctive basis. IVIG treatment involves the administration of pooled human gamma-globulin and improvement occurs in a few days (Hickey, 2014). The effects of IVIG typically last only about 28 days after infusion, and complications include headache, migraine exacerbation, aseptic meningitis, and flulike symptoms (Cherin, Marie, Michallet, et al., 2016).

A number of medications are contraindicated for patients with myasthenia gravis because they exacerbate the symptoms. The primary provider and the patient should weigh risks and benefits before any new medications are prescribed. Procaine (Novocaine) should be avoided, and the patient's dentist is informed of the diagnosis of myasthenia gravis.

Therapeutic Plasma Exchange

A technique called TPE, formerly referred to as plasmapheresis, is used to treat exacerbations. The patient's plasma and plasma components are removed through a centrally placed large-bore double-lumen catheter. The blood cells and antibody-containing plasma are separated, after which the cells and a plasma substitute are reinfused. Temporary reduction in the level of circulating antibodies is provided with TPE. A typical course consists of daily or alternate-day treatment, and the number of treatments is determined by the patient's response. Symptoms improve in 75% of patients undergoing TPE; however, improvement lasts only a few weeks after treatment is completed (Hickey, 2014).

Surgical Management

Thymectomy (surgical removal of the thymus gland) can produce antigen-specific immunosuppression and result in clinical improvement. This surgery is frequently performed in patients younger than 65 years who have had myasthenia gravis diagnosed within the past 3 years. It is the only treatment that can result in complete remission, which occurs in approximately 35% of patients (Hickey, 2014). Improvements may take several months to several years after surgery to occur. A course of preoperative TPE decreases the time needed for postoperative mechanical ventilation.

The entire thymus gland must be removed for optimal clinical outcomes. There are three surgical approaches: transsternal, transcervical thymectomy, and video-assisted thoracoscopic surgery (AANN, 2013). After surgery, the patient is monitored in an intensive care unit, with special attention to respiratory function. The patient is weaned from mechanical ventilation after thorough respiratory assessment. After the thymus gland is removed, it may take up to 3 years for the patient to benefit from the procedure because of the long life of circulating T cells. The earlier the surgery in the disease process, the better the prognosis (Bader et al., 2016).

Complications

A myasthenic crisis is an exacerbation of the disease process characterized by severe generalized muscle weakness and respiratory and bulbar weakness that may result in respiratory failure. Crisis may result from disease exacerbation or a specific precipitating event. The most common precipitator is respiratory infection; others include medication change, surgery, pregnancy, and medications that exacerbate myasthenia. A cholinergic crisis caused by overmedication with cholinesterase inhibitors is rare (AANN, 2013).

Neuromuscular respiratory failure is the critical complication in myasthenic and cholinergic crises. Respiratory muscle and bulbar weakness combine to cause respiratory compromise. Weak respiratory muscles do not support inhalation. An inadequate cough and an impaired gag reflex, caused by bulbar weakness, result in poor airway clearance. A downward trend of two respiratory function tests, the negative inspiratory force and vital capacity, is the first clinical sign of respiratory compromise.

Endotracheal intubation and mechanical ventilation may be needed (see Chapter 11). Noninvasive positive-pressure ventilation uses an external device in the form of a vest that provides respiratory support without endotracheal intubation. Cholinesterase inhibitors are stopped when respiratory failure

occurs and gradually restarted after the patient demonstrates improvement with a course of TPE or IVIG. Nutritional support may be needed if the patient is intubated for a long period or swallowing ability is affected (see Chapter 15).

Nursing Management

Because myasthenia gravis is a chronic disease and most patients are seen on an outpatient basis, much of the nursing care focuses on patient and family education. Educational topics for outpatient self-care include medication management, energy conservation, strategies to help with ocular manifestations, and prevention and management of complications.

Medication management is a crucial component of ongoing care. Understanding the actions of the medications and taking them on schedule is emphasized, as are the consequences of delaying medication and the signs and symptoms of myasthenic and cholinergic crises. The patient can determine the best times for daily dosing by keeping a diary to determine fluctuation of symptoms and to learn when the medication is wearing off. The medication schedule can then be manipulated to maximize strength throughout the day.

Nursing Alert: Maintenance of stable blood levels of anticholinesterase medications is imperative to stabilize muscle strength. Therefore, the anticholinesterase medications must be given on time. Any delay in administration of medications may exacerbate muscle weakness and make it impossible for the patient to take medications orally.

Regular administration of IVIG or subcutaneous immunoglobulin (SCIG) may be prescribed. The patient and family are educated about managing immunoglobulin therapy.

The procedural guidelines for management of IVIG are discussed in the Procedural Guidelines 52-1.

The patient is also educated about strategies to conserve energy. To do this, the nurse helps the patient identify the optimal times for rest throughout the day. If the patient lives in a two-story home, the nurse can suggest that frequently used items (e.g., hygiene products, cleaning products, snacks) be kept on each floor to minimize travel between floors. Using consistent routines, scheduling periods of rest, monitoring for depression, maintaining good sleep patterns, and incorporating interventions to conserve energy are all strategies to reduce fatigue (Bader et al., 2016).

To minimize the risk of aspiration, mealtimes should coincide with the peak effects of anticholinesterase medication. In addition, rest before meals is encouraged to reduce muscle fatigue. The patient is advised to sit upright during meals, with the neck slightly flexed to facilitate swallowing. Soft foods in gravy or sauces can be swallowed more easily. Eating large meals in the morning and smaller meals in the evening is another good strategy (Bader et al., 2016). Supplemental feedings may be helpful to ensure adequate nutrition.

If choking occurs frequently, the patient should be evaluated by a speech-language pathologist for formal dietary and mechanical techniques to avoid aspiration. Suction should be available at home, with the patient and family instructed in its use.

Impaired vision results from ptosis of one or both eyelids, decreased eye movement, or double vision. To prevent corneal damage when the eyelids do not close completely, the patient is instructed to tape the eyes closed for short intervals and to regularly instill artificial tears. Patients who wear eyeglasses can have "crutches" attached to help lift the eyelids. Patching of one eye can help with double vision.

The patient is reminded of the importance of maintaining health-promotion practices and following health care screening recommendations. Factors that exacerbate symptoms and potentially cause crisis should be noted and avoided: emotional stress, infections (particularly respiratory infections), vigorous physical activity, some medications, and high environmental temperature. The Myasthenia Gravis Foundation of America provides support groups, services, and educational materials for patients, families, and health care providers (see the Resources section).

Myasthenic Crisis

Respiratory distress and varying degrees of dysphagia, dysarthria (difficulty speaking), eyelid ptosis, diplopia, and prominent muscle weakness are symptoms of myasthenic crisis. The patient is placed in an intensive care unit for constant monitoring because of associated intense and sudden fluctuations in clinical condition.

Providing ventilatory assistance takes precedence in the immediate management of the patient with myasthenic crisis. Ongoing assessment for respiratory failure is essential. The nurse assesses the respiratory rate, depth, and breath sounds and monitors pulmonary function parameters (vital capacity and negative inspiratory force) to detect pulmonary problems before respiratory dysfunction progresses. Blood is drawn for arterial blood gas analysis. Endotracheal intubation and mechanical ventilation may be needed (see Chapter 11).

If the abdominal, intercostal, and pharyngeal muscles are severely weak, the patient cannot cough, take deep breaths, or clear secretions. Chest physiotherapy, including postural drainage to mobilize secretions and suctioning to remove secretions, may have to be performed frequently. (Postural drainage should not be performed for 30 minutes after feeding.)

Assessment strategies and supportive measures include the following:

- Arterial blood gases, serum electrolytes, input and output, and daily weight are monitored.
- If the patient cannot swallow, enteral tube feedings may be prescribed (see Chapter 15).
- Sedative and tranquilizing agents are avoided, because they aggravate hypoxia and hypercapnia and can cause respiratory and cardiac depression.

Guillain–Barré Syndrome (GBS)

GBS, also known as acute idiopathic polyneuritis, is an autoimmune attack on the peripheral nerve myelin. The result is acute, rapid segmental demyelination of peripheral nerves and some cranial nerves, producing ascending weakness with dyskinesia (inability to execute voluntary movements), hyporeflexia, and paresthesias (a sensation of numbness, tingling, or a "pins and needles" sensation). An antecedent event (most often a viral infection) precipitates clinical presentation in approximately 60% to 70% of cases (Bader et al., 2016). *Campylobacter jejuni* (implicated in 24% to 50% of cases), cytomegalovirus, Epstein–Barr virus, *Mycoplasma pneumoniae, H. influenzae,* and HIV are the most common infectious agents that are associated with the development of GBS.

Procedural Guidelines 52-1

Managing Immunoglobulin Therapy

Immunoglobulin therapy is an important treatment for a variety of disease states that are characterized by deficient production of antibodies. Immunoglobulin can be administered for replacement therapy as an IV infusion or subcutaneous (SC) injection. It can safely be administered in outpatient as well as inpatient settings.

Equipment (as needed)

- Single-use tourniquet
- Single-use scissors or clippers for hair removal
- IVIG solution, tubing, connector, catheter, or syringe
- Chlorhexidine gluconate, povidone–iodine, or alcohol swabs
- Nonlatex gloves
- Transparent dressing, bandage, or sterile gauze
- Padded, appropriate-length arm board
- Tape
- Topical analgesics
- Preservative-free 0.9% NaCl flush solution
- Padded, appropriate-length arm board or finger splint
- Electronic infusion pump

Implementation

Nursing Actions	Rationale
1. Verify prescription for IVIG therapy and identify patient.	1. Serious errors can be avoided by careful checking. Immunoglobulin is supplied in a 5% solution or a lyophilized powder with a reconstituting diluent prepared from Cohn fraction II obtained from pools of 1,000–20,000 donors. Currently, a number of different IV preparations are approved for use and have been shown to be effective and safe by the U.S. Food and Drug Administration. Immunoglobulin can also be administered via SC injection.
2. Check for allergies (i.e., latex, iodine).	2. Checking for allergies reduces risk of allergic reaction.
3. Explain procedure to patient.	3. Knowledge increases patient comfort and cooperation.
4. Perform hand hygiene, and put on disposable nonlatex gloves.	4. Asepsis is essential to prevent infection. The use of nonlatex gloves prevents exposure of nurse to patient's blood and of patient and nurse to latex.
5. Obtain height and weight of patient before treatment.	5. Obtaining Ht. and Wt. helps verify accurate dosing.
6. Assess baseline vital signs before, during, and after treatment.	6. An elevated temperature at the beginning of treatment may be an indication to delay the therapy to avoid misinterpreting this as an adverse reaction.
7. Premedicate with acetaminophen/paracetamol (Tylenol) and diphenhydramine (Benadryl) as prescribed 30 minutes before the start of infusion therapy. Corticosteroids may be prescribed as well.	7. Premedicating may help avert adverse reactions. Corticosteroids may be used to prevent possible severe reactions in patients who are perceived to be at risk.
8. Verify the route and dose of IVIG therapy.	8. IVIG can be administered via the IV or SC routes. The optimal dose is determined by the patient's response. In most instances, an IV dose of 200–800 mg/kg of body weight is administered every 3–4 weeks to ensure adequate serum levels of immunoglobulin G (IgG).
9. Insert IV cannula or catheter according to Guidelines for Starting a Peripheral Intravenous Infusion, as needed.	9. Patient may need IV access, may have a port or long-term catheter for an IV infusion.
10. Administer the IV infusion at a slow rate, not to exceed 3 mL/min, usually at 100–200 mL/h.	10. Administer according to manufacturer's instructions. Beginning at a slow rate helps minimize adverse reactions.
11. Continually assess the patient for adverse reactions.	11. Be aware of complaints of a tickle or lump in the throat as the precursor to laryngospasm that precedes bronchoconstriction. Caution should be exercised when changing IVIG products, because they are not biologically equivalent. Understand that long-term tolerance of an older IVIG product does not necessarily imply tolerance to a newer product, even if it is technically superior.
12. Stop IV infusion at the first sign of reaction.	12. Initiate the institutional protocol to be followed in an emergent situation. Patients who have an IgA deficiency have IgE antibodies to IgA, which requires administration of plasma or immunoglobulin replacement from IgA-deficient patients. Because all IV immunoglobulin preparations contain some IgA, they may cause an anaphylactic reaction in patients with IgE anti-IgA antibodies.
13. Administer SC immunoglobulin as orders.	13. The pharmacokinetics of IgG differ when smaller doses are given more frequently, as is commonly done with SC regimens.

Adapted from Cherin, P., Marie, I., Michallet, M., et al. (2016). Management of adverse events in the treatment of patients with immunoglobulin therapy: A review of evidence. Autoimmunity Reviews, 15, 71–81.

There are several types of GBS. With the most well-known type, the patient experiences weakness in the lower extremities, which progresses upward and has the potential for respiratory failure. The second type is purely motor with no altered sensation. A third type, called descending GBS, is much more difficult to diagnose; it mostly affects the head and neck muscles. The rarest type, the Miller–Fisher variant, presents with ataxia, areflexia, and ophthalmoplegia (McNair, 2013).

The annual incidence of GBS is 1 to 2 cases per 100,000 people, and it is more frequent in males between 16 and 25 years of age and those older than 55 years (Bader et al., 2016). Death occurs in 5% to 10% of cases, resulting from respiratory failure, autonomic dysfunction, sepsis, or pulmonary embolism (PE) (Hickey, 2014). There is scanty data available about the incidence or prevalence of GBS in India. However, some of the studies from Europe and Asia have reported familial relationship in the occurrence of this disease. Same familial relations in the occurrence of GBS have been reported by a hospital-based study conducted in South India, where 150 GBS patients were studied for a period of 10 years (Naik, Saroja, & Patil, 2012); (Rastogi, 2016). Association of Zika virus and GBS has been reported by nine different countries during 2015 and 2016 (WHO, 2016).

Pathophysiology

Myelin is a complex substance that covers nerves, providing insulation and speeding the conduction of impulses from the cell body to the dendrites. The cell that produces myelin in the peripheral nervous system is the Schwann cell. In GBS, the Schwann cell can be spared, allowing for remyelination in the recovery phase of the disease. If damage has occurred to the axons, then regrowth is required and takes months or years and is often incomplete (Hickey, 2014).

GBS is the result of a cell-mediated and humoral immune attack on peripheral nerve myelin proteins that causes inflammatory demyelination. The best-accepted theory of cause is molecular mimicry, in which an infectious organism contains an amino acid that mimics the peripheral nerve myelin protein. The immune system cannot distinguish between the two proteins and attacks and destroys peripheral nerve myelin. The exact location of the immune attack within the peripheral nervous system is the ganglioside GM1b. With the autoimmune attack, there is an influx of macrophages and other immune-mediated agents that attack myelin and cause inflammation and destruction, interruption of nerve conduction, and axonal loss (Hickey, 2014). Pathophysiology of GBS is also presented in Figure 52-14.

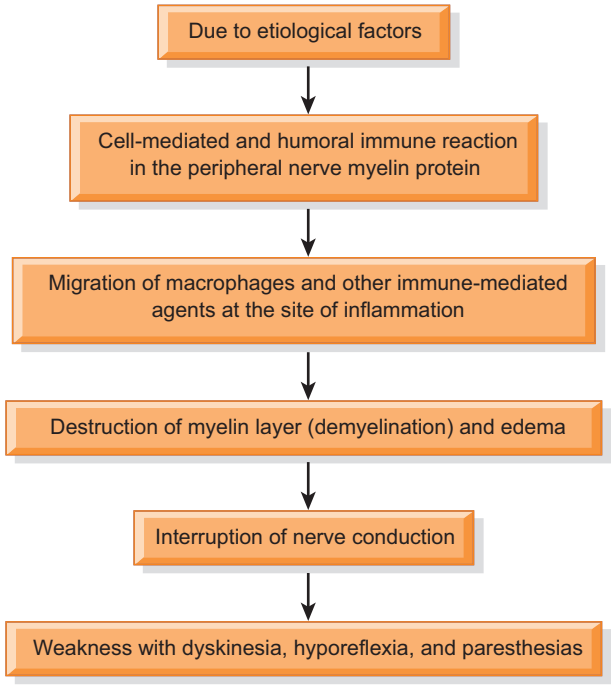


Figure 52-14 • Pathophysiology of Guillain–Barré syndrome.

Clinical Manifestations

GBS typically begins with muscle weakness and diminished reflexes of the lower extremities. Hyporeflexia and weakness may progress to tetraplegia. Demyelination of the nerves that innervate the diaphragm and intercostal muscles results in neuromuscular respiratory failure. Sensory symptoms include paresthesias of the hands and feet and pain related to the demyelination of sensory fibers.

The antecedent event usually occurs 1 to 3 weeks before symptoms begin. Weakness usually begins in the legs and may progresses upward. Maximum weakness (the plateau) varies in length but usually includes neuromuscular respiratory failure and bulbar weakness. GBS progresses to peak severity typically within 2 weeks and no longer than 4 weeks. If progression is longer, then the patient is classified as having chronic inflammatory demyelinating polyneuropathy (Hickey, 2014). Any residual symptoms are permanent and reflect axonal damage from demyelination.

Cranial nerve demyelination can result in a variety of clinical manifestations. Optic nerve demyelination may result in blindness. Bulbar muscle weakness related to demyelination of the glossopharyngeal and vagus nerves results in the inability to swallow or clear secretions. Vagus nerve demyelination results in autonomic dysfunction, manifested by instability of the cardiovascular system. The presentation is variable and may include tachycardia, bradycardia, hypertension, or orthostatic hypotension. The symptoms of autonomic dysfunction occur and resolve rapidly. GBS does not affect cognitive function or LOC.

Although the classic clinical features include areflexia and ascending weakness, variations in the clinical presentation occurs. There may be a sensory presentation, with progressive sensory symptoms; an atypical axonal destruction; or the Miller–Fisher variant, which includes paralysis of the ocular muscles, ataxia, and areflexia (McNair, 2013).

Assessment and Diagnostic Findings

The patient presents with symmetric weakness, diminished reflexes, and upward progression of motor weakness. A history of a viral illness in the previous few weeks suggests the diagnosis. Changes in vital capacity and negative inspiratory force are assessed to identify impending neuromuscular respiratory failure. Serum laboratory tests are not useful in the diagnosis. However, elevated protein levels are detected in CSF evaluation, without an increase in other cells. Evoked potential studies demonstrate a progressive loss of nerve conduction velocity.

Medical Management

Because of the possibility of rapid progression and neuromuscular respiratory failure, GBS is a medical emergency that may require management in an intensive care unit. After baseline values are identified, assessment of changes in muscle

strength and respiratory function alert the clinician to the physical and respiratory needs of the patient. Respiratory therapy or mechanical ventilation may be necessary to support pulmonary function and adequate oxygenation. Some clinicians recommend elective intubation before the onset of extreme respiratory muscle fatigue. Emergent intubation may result in autonomic dysfunction, and mechanical ventilation may be required for an extended period. The patient is weaned from mechanical ventilation after the respiratory muscles can again support spontaneous respiration and maintain adequate tissue oxygenation.

Other interventions are aimed at preventing the complications of immobility. These may include the use of anticoagulant agents and sequential compression boots to prevent venous thromboembolism (VTE), including deep vein thrombosis (DVT) and PE.

TPE and IVIG are used to directly affect the peripheral nerve myelin antibody level. Both therapies decrease circulating antibody levels and reduce the amount of time the patient is immobilized and dependent on mechanical ventilation. The cardiovascular risks posed by autonomic dysfunction require continuous electrocardiographic (ECG) monitoring. Tachycardia and hypertension are treated with short-acting medications such as alpha-adrenergic blocking agents. The use of short-acting agents is important, because autonomic dysfunction is very labile. Hypotension is managed by increasing the amount of IV fluid administered.

NURSING PROCESS

The Patient with GBS

Assessment

Ongoing assessment for disease progression is critical. The patient is monitored for life-threatening complications (respiratory failure, cardiac dysrhythmias, VTE [including DVT or PE]) so that appropriate interventions can be initiated. Because of the threat to the patient in this sudden, potentially life-threatening disease, the nurse must assess the patient's and family's ability to cope and their use of coping strategies.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Ineffective breathing pattern and impaired gas exchange related to rapidly progressive weakness and impending respiratory failure
- Impaired bed and physical mobility related to paralysis
- Imbalanced nutrition: less than body requirements related to inability to swallow
- Impaired verbal communication related to cranial nerve dysfunction
- Fear and anxiety related to loss of control and paralysis

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Respiratory failure
- Autonomic dysfunction

Planning and Goals

The major goals for the patient may include improved respiratory function, increased mobility, improved nutritional status, effective communication, decreased fear and anxiety, and absence of complications.

Nursing Interventions

Maintaining Respiratory Function

Respiratory function can be maximized with incentive spirometry and chest physiotherapy. Monitoring for changes in vital capacity and negative inspiratory force is key to early intervention for neuromuscular respiratory failure. Mechanical ventilation is required if the vital capacity falls, making spontaneous breathing impossible and tissue oxygenation inadequate.

The potential need for mechanical ventilation should be discussed with the patient and family on admission to provide time for psychological preparation and decision making. Intubation and mechanical ventilation result in less anxiety if they are initiated on a nonemergency basis to a patient who has been well informed. The patient may require mechanical ventilation for a long period. See Chapter 11 for the nursing management of the patient requiring mechanical ventilation.

Bulbar weakness that impairs the ability to swallow and clear secretions is another factor in the development of respiratory failure in the patient with GBS. Suctioning may be needed to maintain a clear airway.

The nurse assesses the blood pressure and heart rate frequently to identify autonomic dysfunction so that interventions can be initiated quickly if needed. Medications are given or a temporary pacemaker placed for clinically significant bradycardia.

Enhancing Physical Mobility

Nursing interventions to enhance physical mobility and prevent the complications of immobility are key to the function and survival of patients. The paralyzed extremities are supported in functional positions, and passive range-of-motion exercises are performed at least twice daily. DVT and PE are threats to the patient who is paralyzed. Nursing interventions are aimed at preventing VTE. Range-of-motion exercises, position changes, anticoagulation, the use of antiembolism stockings and sequential compression boots, and adequate hydration decrease the risk of VTE.

Padding may be placed over bony prominences, such as the elbows and heels, to reduce the risk of pressure ulcers. The need for frequent position changes cannot be overemphasized. The nurse evaluates laboratory test results that may indicate malnutrition or dehydration, both of which increase the risk of pressure ulcers and decrease mobility. The nurse collaborates with the primary provider and dietitian to develop a plan to meet the patient's nutritional and hydration needs.

Providing Adequate Nutrition

Paralytic ileus may result from insufficient parasympathetic activity. In this event, the nurse administers IV fluids and parenteral nutrition as a supplement and monitors for the return of bowel sounds. If the patient cannot swallow because of bulbar paralysis (immobility of muscles), a gastrostomy tube may be placed to administer nutrients. The nurse carefully assesses the return of the gag reflex and bowel sounds before resuming oral nutrition.

Improving Communication

Because of paralysis, the patient cannot talk, laugh, or cry and therefore has no method for communicating needs or expressing emotion. Although the patient may be unable to speak, cognition is completely intact. Establishing some form

of communication with picture cards or an eye blink system provides a means of communication. Collaboration with the speech therapist may be helpful in developing a communication mechanism that is most effective for a specific patient.

Decreasing Fear and Anxiety

The patient and family are faced with a sudden, potentially life-threatening disease; therefore, their levels of anxiety and fear may be high. The impact of disease on the family depends on the patient's role within the family. Referral to a support group may provide information and support to the patient and family.

The family may feel helpless in caring for the patient. Mechanical ventilation and monitoring devices may frighten and intimidate them. Family members often want to participate in physical care; with instruction and support by the nurse, they should be allowed and encouraged to do so.

In addition to fear, the patient may experience isolation, loneliness, and lack of control. Nursing interventions that increase the patient's sense of control include providing information about the condition, emphasizing a positive appraisal of coping resources, and providing instruction about relaxation exercises and distraction techniques. The positive attitude and atmosphere of the multidisciplinary team are important to promote a sense of well-being.

Diversional activities are encouraged to decrease loneliness and isolation. Encouraging visitors, engaging visitors or volunteers to read to the patient, listening to music or books on tape, and watching television are ways to alleviate the patient's sense of isolation.

Monitoring and Managing Potential Complications

Thorough assessment of respiratory function at regular and frequent intervals is essential, because respiratory insufficiency and subsequent failure due to weakness or paralysis of the intercostal muscles and diaphragm may develop quickly. Respiratory failure is the major cause of mortality. In addition to the respiratory rate and the quality of respirations, vital capacity is monitored frequently and at regular intervals so that respiratory insufficiency can be anticipated. Decreasing vital capacity with associated muscle weakness indicates impending respiratory failure. Signs and symptoms include breathlessness while speaking, shallow and irregular breathing, the use of accessory muscles, tachycardia, weak cough, and changes in respiratory pattern.

Other complications include cardiac dysrhythmias (which necessitate ECG monitoring), transient hypertension, orthostatic hypotension, DVT, PE, urinary retention, and other threats to any patient who is immobilized and paralyzed. These complications require monitoring and attention to prevent them and prompt treatment if indicated.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. Patients with GBS and their families are usually frightened by the sudden onset of life-threatening symptoms and their severity. Therefore, educating the patient and family about the disorder and its generally favorable prognosis is important (see Chart 52-5).

During the acute phase of the illness, the patient and family are educated about strategies that can be implemented to minimize the effects of immobility and other complications. As function begins to return, family members and other home care providers are educated about care of the patient and their role in the rehabilitation process. Preparation for discharge is an interdisciplinary effort requiring family or caregiver education by all team members, including the nurse, physician, occupational and physiotherapists, speech therapist, and respiratory therapist.

Continuing and Transitional Care. Most patients with GBS experience complete recovery. Patients who have experienced total or prolonged paralysis require intensive rehabilitation; the extent depends on the patient's needs. Approaches include a comprehensive inpatient program if deficits are significant, an outpatient program if the patient can travel by car, or a home program of physical and occupational therapy. The recovery

Chart 52-5 HOME CARE CHECKLIST

The Patient with GBS

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of GBS and treatment on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State the purpose, dose, route, schedule, side effects, and precautions for prescribed medications.
- State how to contact all members of the treatment team (e.g., health care providers, home care professionals, and durable medical equipment and supply vendor).
- State what types of environmental and safety changes or supports are needed for optimum functioning in the home.
  - State changes in lifestyle (e.g., nutrition, skin care, exercise, activity) necessary during recovery period and to maintain health as indicated.
  - Demonstrate environmental modifications and adaptive techniques for accomplishing ADLs (e.g., bathing, hygiene, grooming, dressing) and safely managing self-care.
  - Manage respiratory needs—tracheostomy care, suctioning.
  - Verbalize dietary adjustments and optimum nutrition during recovery.
  - Demonstrate proper body mechanics regarding lifting and transfers.
  - Practice gait training and strength endurance.
  - Perform range-of-motion exercises.
  - Discuss bowel and bladder management.
  - Operate and explain function of medical equipment and mobility aids—walkers, wheelchairs, bedside commodes, tub transfer benches, adaptive devices.
  - Describe coping mechanisms and diversional activities appropriately.
- Relate how to reach primary provider with questions or complications.
- State time and date of follow-up medical appointments, therapy, and testing.
- Identify sources of support (e.g., friends, relatives).
- Identify the need for health promotion, disease prevention, and screening activities

See Chapters 38 and 51 for additional information on rehabilitation aspects.

ADL, activities of daily living; GBS, Guillain–Barré syndrome; IADL, independent activities of daily living.

phase may be long and requires patience as well as involvement on the part of the patient and family.

During acute care, the focus is on immediate issues and deficits. The nurse needs to remind or educate patients and family members of the need for continuing health-promotion and screening practices after this initial phase of care.

Evaluation

Expected patient outcomes may include the following:

1. Maintains effective respirations and airway clearance
   a. Has clear breath sounds on auscultation
   b. Demonstrates gradual improvement in respiratory function
   c. Breathes spontaneously
   d. Has vital capacity within normal range
   e. Exhibits arterial blood gases and pulse oximetry within normal limits
2. Shows increasing mobility
   a. Regains use of extremities
   b. Participates in rehabilitation program
   c. Demonstrates no contractures and minimal muscle atrophy
3. Receives adequate nutrition and hydration
   a. Consumes diet adequate to meet nutritional needs
   b. Swallows without aspiration
4. Demonstrates recovery of speech
   a. Communicates needs through alternative strategies
   b. Practices exercises recommended by the speech therapist
5. Shows lessening fear and anxiety
6. Has absence of complications
   a. Maintains intact skin integrity
   b. Does not develop VTE
   c. Voids without difficulty

CRANIAL NERVE DISORDERS

Because the brainstem and cranial nerves involve vital motor, sensory, and autonomic functions of the body, these nerves may be affected by conditions arising primarily within these structures or in secondary extension from adjacent disease processes. The cranial nerves are examined separately and in sequence (see Chapter 48). Some cranial nerve deficits can be detected by observing the patient's face, eye movements, speech, and swallowing. EMG is used to investigate motor and sensory dysfunction. An MRI scan is used to obtain images of the cranial nerves and brainstem. An overview of disorders that may affect each of the cranial nerves, including clinical manifestations and nursing interventions, is presented in Table 52-2. The following discussion centers on the most common disorders of the cranial nerves: trigeminal neuralgia, a condition affecting the fifth cranial nerve, and Bell palsy, caused by involvement of the seventh cranial nerve.

Trigeminal Neuralgia (Tic Douloureux)

Trigeminal neuralgia is a condition of the fifth cranial nerve that is characterized by paroxysms of sudden pain in the area innervated by any of the three branches of the nerve

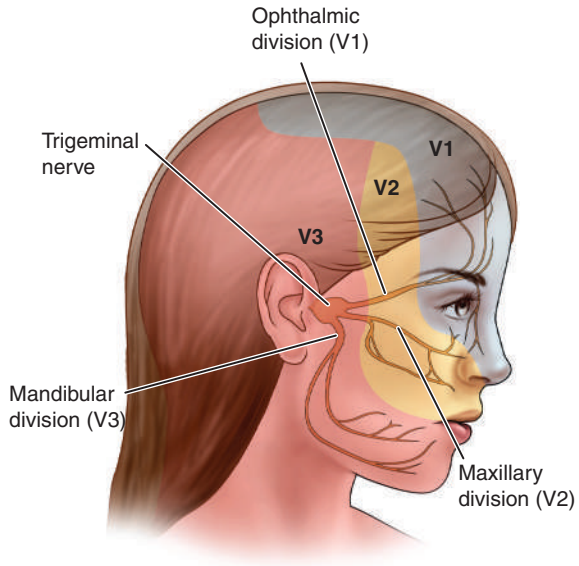


Figure 52-15 • Distribution of trigeminal nerve branches—the fifth cranial nerve.

(Bader et al., 2016) (see Fig. 52-15). The pain ends as abruptly as it starts and is described as a unilateral shooting and stabbing or burning sensation. The unilateral nature of the pain is an important feature. Associated involuntary contraction of the facial muscles can cause sudden closing of the eye or twitching of the mouth, hence the former name *tic douloureux* (painful twitch). Although the cause is not certain, it is thought to be demyelination of axons in the ganglion, root, and nerve (Grossman & Porth, 2014).

Trigeminal neuralgia occurs most often as people age, most commonly between the fifth and sixth decades of life. It is more common in men and in people from urban areas (Yadav, Mittal, Sachdeva, et al., 2015).

Trigeminal neuralgia occurs most often as people age, most commonly between the fifth and sixth decade of life. It is more common in women and in people with MS compared to the general population (Bader et al., 2016). Patients who develop trigeminal neuralgia before age 50 years should be evaluated for the coexistence of MS, because trigeminal neuralgia occurs in approximately 5% of patients with MS (Bader et al., 2016). Pain-free intervals may be measured in terms of minutes, hours, days, or longer. With advancing years, the painful episodes tend to become more frequent and agonizing. The patient lives in constant fear of attacks.

Paroxysms can occur with any stimulation of the terminals of the affected nerve branches, such as washing the face, shaving, brushing the teeth, eating, and drinking. A draft of cold air or direct pressure against the nerve trunk may also cause pain. Certain areas are called *trigger points* because the slightest touch immediately starts a paroxysm or episode. To avoid stimulating these areas, patients with trigeminal neuralgia try not to touch or wash their faces, shave, chew, or do anything else that might cause an attack. These behaviors are a clue to the diagnosis.

Medical Management

Pharmacologic Therapy

Anticonvulsant agents, such as carbamazepine (Tegretol), relieve pain in most patients with trigeminal neuralgia by reducing

TABLE 52-2 Disorders of Cranial Nerves

Disorder	Clinical Manifestations	Nursing Interventions
Olfactory Nerve—I		
Head trauma Intracranial tumor Intracranial surgery	Unilateral or bilateral anosmia (temporary or persistent) Diminished taste for food	Assess sense of smell. Assess for cerebrospinal fluid rhinorrhea if patient has sustained head trauma.
Optic Nerve—II		
Optic neuritis Increased intracranial pressure Pituitary tumor	Lesions of optic tract producing homonymous hemianopia	Assess visual acuity. Restructure environment to prevent injuries. Educate patient to accommodate for visual loss.
Oculomotor Nerve—III		Assess extraocular movement and for nonreactive pupil.
Trochlear Nerve—IV		Assess extraocular movement and for nonreactive pupil.
Abducens Nerve—VI		
Vascular Brainstem ischemia Hemorrhage and infarction Neoplasm Trauma Infection	Dilation of pupil with loss of light reflex on one side Impairment of ocular movement Diplopia Gaze palsies Ptosis of eyelid	Assess extraocular movement and for nonreactive pupil.
Trigeminal Nerve—V		
Trigeminal neuralgia Head trauma Cerebellopontine lesion Sinus tract tumor and metastatic disease Compression of trigeminal root by tumor	Pain in face Diminished or loss of corneal reflex Chewing dysfunction	Assess for pain and triggering mechanisms for pain. Assess for difficulty in chewing. Discuss trigger zones and pain precipitants with patient. Protect cornea from abrasion. Ensure good oral hygiene. Educate patient about medication regimen.
Facial Nerve—VII		
Bell palsy Facial nerve tumor Intracranial lesion Herpes zoster	Facial dysfunction; weakness and paralysis Hemifacial spasm Diminished or absent taste Pain	Recognize facial paralysis as emergency; refer for treatment as soon as possible. Discuss protective care for eyes. Select easily chewed foods; patient should eat and drink from unaffected side of mouth. Emphasize importance of oral hygiene. Provide emotional support for changed appearance of face.
Vestibulocochlear Nerve—VIII		
Tumors and acoustic neuroma Vascular compression of nerve Ménière syndrome	Tinnitus Vertigo Hearing difficulties	Assess pattern of vertigo. Provide for safety measures to prevent falls. Ensure that patient can maintain balance before ambulating. Caution patient to change positions slowly. Assist with ambulation. Encourage the use of assistive devices.
Glossopharyngeal Nerve—IX		
Glossopharyngeal neuralgia from neurovascular compression of cranial nerves IX and X Trauma Inflammatory conditions Tumor Vertebral artery aneurysms	Pain at base of tongue Difficulty in swallowing Loss of gag reflex Palatal, pharyngeal, and laryngeal paralysis	Assess for paroxysmal pain in throat, decreased or absent swallowing, and gag and cough reflexes. Monitor for dysphagia, aspiration, and nasal dysarthric speech. Position patient upright for eating or tube feeding.

(Continued)

(Continued)

Vagus Nerve—X		
Spastic palsy of larynx; bulbar paralysis; high vagal paralysis	Voice changes (temporary or permanent hoarseness)	Assess for airway obstruction/provide airway management.
Guillain–Barré syndrome	Vocal paralysis	Prevent aspiration.
Vagal body tumors	Dysphagia	Support patient having voice reconstruction procedures.
Nerve paralysis from malignancy, surgical trauma such as carotid endarterectomy		
Spinal Accessory Nerve—XI		
Spinal cord disorder	Drooping of affected shoulder with limited shoulder movement	Support patient undergoing diagnostic tests.
Amyotrophic lateral sclerosis	Weakness or paralysis of head rotation, flexion, extension; shoulder elevation	
Trauma		
Guillain–Barré syndrome		
Hypoglossal Nerve—XII		
Medullary lesions	Abnormal movements of tongue	Observe swallowing ability.
Amyotrophic lateral sclerosis	Weakness or paralysis of tongue muscles	Observe speech pattern.
Polio and motor system disease, which may destroy hypoglossal nuclei	Difficulty in talking, chewing, and swallowing	Be aware of swallowing or vocal difficulties.
Multiple sclerosis		Prepare for alternate feeding methods (tube feeding) to maintain nutrition.
Trauma		

Adapted from Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses. Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

the transmission of impulses at certain nerve terminals. Carbamazepine is taken with meals. Serum levels must be monitored to avoid toxicity in patients who require high doses to control the pain. Side effects include nausea, dizziness, drowsiness, and aplastic anemia. Serious drug reactions occur more often in people of Asian ethnicity (Bader et al., 2016). The patient is monitored for bone marrow depression during long-term therapy. Gabapentin and baclofen are also used for pain control. If pain control is still not achieved, phenytoin may be used as adjunctive therapy.

Surgical Management

If pharmacologic management fails to relieve pain, a number of surgical options are available. Although these procedures may relieve facial pain for a few years, recurrence and complication rates are high (Hickey, 2014). The choice of procedure depends on the patient's preference and health status. The procedures are designed to either decompress the nerve and save nerve function or to damage the nerve and destroy nerve function to keep it from malfunctioning (Bader et al., 2016).

Microvascular Decompression of the Trigeminal Nerve

An intracranial approach is used to relieve the contact between the cerebral vessel and the trigeminal nerve root entry. With the aid of an operating microscope, the artery loop is lifted from the nerve to relieve the pressure, and a small prosthetic device is inserted to prevent recurrence of impingement on the nerve. The postoperative management is the same as for other intracranial surgeries (see Chapter 49).

Radiofrequency Thermal Coagulation

Percutaneous radiofrequency produces a thermal lesion on the trigeminal nerve. Although immediate pain relief is experienced, dysesthesia of the face and loss of the corneal reflex may occur. The use of stereotactic MRI for identification of the trigeminal nerve followed by gamma knife radiosurgery is being used at some medical centers. Gamma knife radiosurgery is a noninvasive method of delivering focused radiation to the trigeminal nerve; it requires 6 to 8 weeks of treatment for maximal effect to occur (Zakrzewska & Akram, 2011).

Percutaneous Balloon Microcompression

Percutaneous balloon microcompression disrupts large myelinated fibers in all three branches of the trigeminal nerve. After its placement, the balloon is filled with a contrast material for fluoroscopic identification. The balloon compresses the nerve root for 1 minute and provides microvascular decompression (Bader et al., 2016).

Nursing Management

Preventing Pain

Preoperative management of a patient with trigeminal neuralgia occurs mostly on an outpatient basis and includes recognizing factors that may aggravate excruciating facial pain, such as food that is too hot or too cold or jarring of the patient's bed or chair. Even washing the face, combing the hair, or brushing the teeth may produce acute pain. The nurse can assist the patient in preventing or reducing this pain by providing instructions about preventive strategies. Providing cotton pads and room temperature water for washing the face, instructing the patient to rinse with mouthwash after eating if toothbrushing causes pain, and performing personal hygiene during pain-free intervals are all effective strategies. The patient is instructed to take food and fluids at room temperature, to chew on the unaffected side, and to ingest soft foods. The nurse recognizes that anxiety, depression, and insomnia often accompany chronic painful conditions and uses appropriate interventions and referrals. See Chapter 9 for management of patients with chronic pain.

Providing Postoperative Care

Postoperative neurologic assessments are conducted to evaluate the patient for facial motor and sensory deficits in each of the

three branches of the trigeminal nerve. If the surgery results in sensory deficits to the affected side of the face, the patient is instructed not to rub the eye because the pain of a resulting injury will not be detected. The eye is assessed for irritation or redness. Artificial tears may be prescribed to prevent dryness in the affected eye. The patient is cautioned not to chew on the affected side until numbness has diminished. The patient is observed carefully for any difficulty in eating or swallowing foods of different consistencies.

Bell Palsy

Bell palsy (facial paralysis) is caused by unilateral inflammation of the seventh cranial nerve, which results in weakness or paralysis of the facial muscles on the affected side (see Fig. 52-16). Although the cause is unknown, theories include vascular ischemia, viral disease (herpes simplex, herpes zoster), autoimmune disease, or a combination of all of these factors. Most adults with Bell palsy are younger than 45 years (Hickey, 2014).

Bell palsy may be a type of pressure paralysis. The inflamed, edematous nerve becomes compressed to the point of damage, or its blood supply is occluded, producing ischemic necrosis of the nerve. The face is distorted from paralysis of the facial muscles; decreased lacrimation (tearing) occurs; and the patient experiences painful sensations in the face, behind the ear, and in the eye. The patient may also experience speech difficulties and may be unable to eat on the affected side because of weakness or paralysis of the facial muscles. The majority of patients recover completely and Bell palsy rarely recurs (Hickey, 2014).

Medical Management

The objectives of treatment are to maintain the muscle tone of the face and to prevent or minimize denervation. The patient should be reassured that no stroke has occurred and that spontaneous recovery occurs within 3 to 5 weeks in most patients.

Corticosteroid therapy (prednisone) may be prescribed to reduce inflammation and edema; this reduces vascular compression and permits restoration of blood circulation to the nerve. Early administration of corticosteroid therapy appears to diminish the severity of the disease, relieve the pain, and prevent or minimize denervation (Gagyor, Madhok, Daly, et al., 2016).

Facial pain is controlled with analgesic agents. Electrical stimulation may be applied to the face to prevent muscle atrophy. Although most patients recover with conservative treatment, surgical exploration of the facial nerve may be indicated if a tumor is suspected, for surgical decompression of the facial nerve, or for surgical treatment of a paralyzed face (Hickey, 2014).

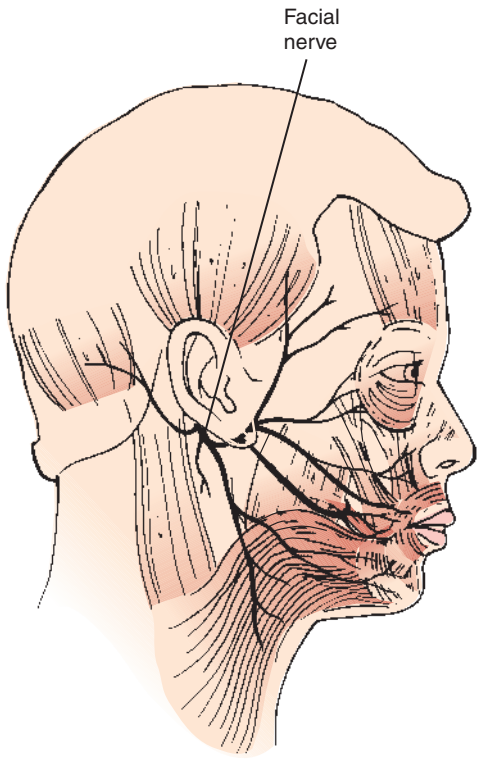


Figure 52-16 • Distribution of the facial nerve—the seventh cranial nerve.

Nursing Management

While the paralysis is present, nursing care involves protection of the eye from injury. Frequently, the eyelid does not close completely and the blink reflex is diminished, so the eye is vulnerable to injury from dust and foreign particles. Corneal irritation and ulceration may occur. Distortion of the lower lid alters the proper drainage of tears. To prevent injury, the eye should be covered with a protective shield at night. The eye patch may abrade the cornea, however, because there is some difficulty in keeping the partially paralyzed eyelids closed. Moisturizing eye drops during the day and eye ointment at bedtime may help prevent injury (Hickey, 2014). The patient can be educated to close the paralyzed eyelid manually before going to sleep. Wraparound sunglasses or goggles may be worn during the day to decrease evaporation from the eye.

After the sensitivity of the nerve to touch decreases and the patient can tolerate touching the face, the nurse can suggest massaging the face several times daily, using a gentle upward motion, to maintain muscle tone. Facial exercises, such as wrinkling the forehead, blowing out the cheeks, and whistling, may be performed with the aid of a mirror to prevent muscle atrophy. Exposure of the face to cold and drafts is avoided.

DISORDERS OF THE PERIPHERAL NERVOUS SYSTEM

Peripheral Neuropathies

A peripheral neuropathy (disorder of the nervous system) is a disorder affecting the peripheral motor and sensory nerves. Peripheral nerves connect the spinal cord and brain to all other organs. They transmit motor impulses from the brain and relay sensory impulses to the brain. Peripheral neuropathies are characterized by bilateral and symmetric disturbance of function, usually beginning in the feet and hands. The most common cause of peripheral neuropathy is diabetes with poor glycemic control. The major symptoms of peripheral nerve disorders are loss of sensation, muscle atrophy, weakness, diminished reflexes, pain, and paresthesia of the extremities.

Peripheral nerve disorders are diagnosed by history, physical examination, and electrodiagnostic studies such as EEG. The diagnosis of peripheral neuropathy in the geriatric population is challenging because many symptoms, such as decreased reflexes, can be associated with the normal aging process (Eliopoulos, 2018).

No specific treatment exists for peripheral neuropathy. Elimination or control of the cause may slow progression. Patients

with peripheral neuropathy are at risk for falls, thermal injuries, and skin breakdown. The plan of care includes inspection of the lower extremities for skin breakdown. Assistive devices such as a walker or cane may decrease the risk of falls. Bathwater temperature is checked to avoid thermal injury. Footwear should be accurately sized. Driving may be limited or eliminated, thereby disrupting the patient's sense of independence.

Mononeuropathy

Mononeuropathy is limited to a single peripheral nerve and its branches. It arises when the trunk of the nerve is compressed or entrapped (as in carpal tunnel syndrome), traumatized (as when bruised by a blow), overstretched (as in joint dislocation), punctured by a needle used to inject a drug or damaged by the drugs thus injected, or inflamed because an adjacent infectious process extends to the nerve trunk. Mononeuropathy is frequently seen in patients with diabetes.

Pain is seldom a major symptom of mononeuropathy when the condition is due to trauma, but in patients with complicating inflammatory conditions such as arthritis, pain is prominent. Pain is increased with all body movements that tend to stretch, strain, or cause pressure on the injured nerve and sudden jarring of the body (e.g., from coughing or sneezing). The skin in the areas supplied by nerves that are injured or diseased may become reddened and glossy, the subcutaneous tissue may become edematous, and the nails and hair in this area are altered. Chemical injuries to a nerve trunk, such as those caused by drugs injected into or near it, are often permanent.

The objective of treatment of mononeuropathy is to remove the cause, if possible (e.g., freeing the compressed nerve). Local corticosteroid injections may reduce inflammation and the pressure on the nerve. Aspirin or codeine may be used to relieve pain. Chronic pain can be treated with neuropathic pain medications such as gabapentin (Bader et al., 2016).

Nursing care involves protection of the affected limb or area from injury, as well as appropriate patient education about mononeuropathy and its treatment.

CRITICAL THINKING EXERCISES

1. A 19-year-old patient is admitted with suspected meningitis. Describe the pathophysiology of meningitis. What are the signs of meningeal irritation the nurse should watch for and how are they tested? What is the priority nursing diagnosis in the patient with meningitis? What history and physical findings are common in the patient with meningitis?
2. Identify the priorities, approach, and techniques you would use to provide care to the patients in your assignment on an intermediate neuroscience unit. Two of the patients have a diagnosis of myasthenia gravis, one is intubated and on a ventilator, one patient has a diagnosis of GBS and the other has meningitis. What tasks can you delegate and to whom?
3. A 35-year-old woman is newly diagnosed with Bell palsy. Identify her treatment options. Describe the evidence base for the options that you have identified and the criteria used to evaluate the strength of the evidence for her various treatment options.

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

American Association of Neuroscience Nurses (AANN). (2013). Care of the patient with myasthenia gravis: AANN patient guideline series. Glenview, IL: Author.

Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Eliopoulos, C. (2018). Gerontological nursing (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Grossman, S. C., & Porth, C. M. (2014). Pathophysiology: Concepts of altered health states (9th ed.) Philadelphia, PA: Lippincott Williams & Wilkins.

Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Jankovic, J. (2022). Neuroepidemiology in Bradley and Daroffs' (Ed). Neurology in clinical practice (8th ed). USA, TX: Elsevier.

Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

Buhse, M. (2015). The elderly person with multiple sclerosis: Clinical implications for the increase life-span. Journal of Neuroscience Nursing, 47(6), 333–339.

Centers for Disease Control and Prevention (CDC). (2016). *Recommended adult immunization schedule—United States, 2016*. Retrieved on 8/20/2016 at: www.cdc.gov/vaccines/schedules/hcp/adult.html

Cherin, P., Marie, I., Michallet, M., et al. (2016). Management of adverse events in the treatment of patients with immunoglobulin therapy: A review of evidence. Autoimmunity Reviews, 15, 71–81.

Del Brutto, O. H. (2012). Neurocysticercosis: a review. The Scientific World Journal Volume. Article ID 159821, doi:10.1100/2012/159821.

Digre, K., & Brennan, K. (2012). Shedding light on photophobia. Journal of Neuro-ophthalmology, 32(1), 68–81.

Filipi, M., Beavin, J., Brillante, R., et al. (2014). Nurses' perspective on approaches to limit flu-like symptoms during interferon therapy for multiple sclerosis. International Journal of MS Care, 16, 55–60.

Gagyor, I., Madhok, V., Daly, F., et al. (2016). Corticosteroids for Bell's palsy (idiopathic facial paralysis). Cochrane Database of Systematic Reviews, 7, CN-01208827.

**Lublin, F. D., & Reingold, S. C. (1996). Defining the clinical course of multiple sclerosis: Results of an international study. Neurology, 46(4), 907–911.

Muzumdar, D., Jhawar, S., Goel, A. (2011). Brain abscess: An overview. International Journal of Surgery, 9, 136–44.

Mcilvoy, L. (2014). Respiratory failure from a myasthenic crisis. American Nurse Today, 9(9), 28.

McNair, N. (2013). Treatment of Guillain-Barré syndrome. The Art and Science of Infusion Nursing, 36(6), 397–400.

Mehndiratta, M. M., Bajaj, B. K., Gupta, M., Anand, R., Tatke, M., Seryam, S. et al. (2001). Creutzfeldt-Jakob disease: report of 10 cases from North India. Neurology India, 49(4), 338.

*Morrison, J. D., & Stuifbergen, A. K. (2016). Predictors of fatigue impact in persons with long-standing multiple sclerosis. Journal of Neuroscience Nursing, 48(3), 143–150.

Naik, K. R., Saroja, A. O., & Patil, B. P. (2012). Familial Guillain-Barré syndrome: First Indian report. Annals of Indian Academy of Neurology, 15(1), 44.

National Institute of Neurological Disorders and Stroke (NINDS). (2016). *Creutzfeldt-Jakob Disease Fact Sheet*. Retrieved on 10/03/16 at: www.ninds.nih.gov/disorders/cjd/detail_cjd.htm.

National Meningitis Association. (2016). *Fact sheet: Meningitis*. Retrieved on 12/14/2016 at: www.nmaus.org/disease-prevention-information/is-it-viral-bacterial-or-fungal/

*Newland, P., Jensen, M. P., Budhathoki, C., et al. (2015). Secondary health conditions in individuals with multiple sclerosis: A cross-sectional web-based survey analysis. Journal of Neuroscience Nursing, 47(3), 124–130.

Rastogi, A. (2016). Guillain-Barré syndrome | National Health Portal Of India. Retrieved March 14, 2018, from https://www.nhp.gov.in/disease/neurological/guillain-barr-syndrome

Riley, C., & Vargus, W. (2015). Multiple sclerosis in the elderly: Considerations in the geriatric population for diagnosis and management. Current Geriatrics Reports, 4(2), 131–141.

Shankar, S. K., & Chandra, P. (1997). Creutzfeld–Jakob disease in Western India in 30 years (1968–1997). CJD Registry NIMHANS, Bangalore, India

Sinclair, D., Preziosi, M., John, T. J, Greenwood B, (2010). The epidemiology of meningococcal disease in India. Tropical Disease and International Health, 15(2), 1421–1435.

Singhal, B. (2015). Multiple sclerosis-Indian perspective. Neurology India, 63(6), 824.

Singhal, B. S., Bhatia, N. S., Umesh, T., & Menon, S. (2008). Myasthenia gravis: a study from India. Neurology India, 56(3), 352.

Slazinski, T. (2013). Brain abscess. Critical Care Nursing Clinics of North America, 25, 381–388.

Theroux, N., Phipps, M., Zimmerman, L., et al. (2013). Neurological complications associated with HIV and AIDS: Clinical implications for nursing. Journal of Neuroscience Nursing, 45(1), 5–13.

Tiwari, S., Singh, R. K., Tiwari, R., Dhole, T. N. (2012). Japanese encephalitis: a review of the Indian perspective. Brazilian Journal of Infectious Diseases, 6(6). Retrieved on 05/04/2018 at: http://:dx.doi.org/10.106/j.biid.2012.10.004.

Vacca, V. (2016). Understanding Creutzfeldt-Jakob disease. Nursing 2016, 46(3), 36–42.Wu, G., & Alvarez, E. (2016). The immune-pathophysiology of MS. Retrieved on 10/03/16 at: www.ncbi.nlm.nih.gov

WHO. (2016). Zika virus, microcephaly and Guillain-Barré syndrome situation report. Retrieved on 03/04/2018 at: http://origin.searo.who.int/bhutan/who-zika-28-7-16.pdf/

Yadav, S., Mittal, H.-C., Sachdeva, A., Verma, A., Dhupar, V., & Dhupar, A. (2015). A retrospective study of 72 cases diagnosed with idiopathic trigeminal neuralgia in indian populace. Journal of Clinical and Experimental Dentistry, 7(1), e40.

Zakrzewska, J. M., & Akram, H. (2011). Neurosurgical interventions for the treatment of classical trigeminal neuralgia. Cochrane Database of Systematic Reviews, (9), CD007312.

Resources

Creutzfeldt-Jakob Disease Foundation, www.cjdfoundation.org
Guillain–Barré Syndrome Foundation International, www.gbs-cidp.org
Myasthenia Gravis Foundation of America (MGFA), www.myasthenia.org
Neurological Society of India, http://www.neurosocietyindia.com/
The Foundation for Neuropathy, www.foundationforpn.org

CHAPTER 53

Management of Patients with Oncologic or Degenerative Neurologic Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe brain and spinal cord tumors: their classification, pathophysiology, clinical manifestations, diagnosis, and medical and nursing management.
2. Use the nursing process as a framework for care of patients with nervous system metastases or primary brain tumor.
3. Explain the pathophysiologic processes responsible for various neurodegenerative disorders.
4. Prepare a nursing care plan for a patient with Alzheimer disease.
5. Apply the nursing process as a framework for care of patients with Parkinson disease.
6. Identify resources for patients and families with oncologic and degenerative neurologic disorders.
7. Use the nursing process as a framework for care of patients following a cervical discectomy.

GLOSSARY

bradykinesia: abnormally slow voluntary movements and speech
chorea: rapid, jerky, involuntary, purposeless movements of the extremities or facial muscles, including facial grimacing
dementia: broad term for a syndrome characterized by a general decline in higher brain functioning, such as reasoning, with a pattern of eventual decline in ability to perform even basic activities of daily living, such as toileting and eating
dyskinesia: impaired ability to execute voluntary movements
dysphonia: voice impairment or altered voice production
neurodegenerative: a disease, process, or condition leading to deterioration of cells or function of the nervous system
papilledema: edema of the optic nerve usually due to increased intracranial pressure (ICP)
paresthesia: numbness, tingling, or a "pins and needles" sensation
sciatica: pain and tenderness that radiates along the sciatic nerve that runs through the thigh and leg
spondylosis: degenerative changes occurring in a disc and adjacent vertebral bodies; can occur in the cervical or lumbar vertebrae

Introduction

The occurrence of oncologic or degenerative disease processes in the neurologic system produces a unique set of nursing challenges. Thus nurses who care for patients with these disorders must have a clear understanding of the pathophysiology, diagnostic testing, medical and nursing care, and rehabilitation processes. Nurses care for patients with oncologic or degenerative disease processes in many inpatient and outpatient settings. Oncologic disorders include brain and spinal cord tumors. Degenerative neurologic disorders include Parkinson disease (PD), Huntington disease, amyotrophic lateral sclerosis (ALS), muscular dystrophies, and degenerative disc disease. Post-polio syndrome (PPS) is thought to be degenerative in nature and is included in this chapter.

ONCOLOGIC DISORDERS OF THE BRAIN AND SPINAL CORD

There are many types of brain and spinal cord tumors, each with its own biology, prognosis, and treatment options. Because of the unique anatomy and physiology, tumors of the central nervous system (CNS) are challenging to diagnose and treat.

Brain Tumors

A brain tumor occupies space within the skull, growing as a spherical mass or diffusely infiltrating tissue. The effects of brain tumors are caused by inflammation, compression, and infiltration of tissue. A variety of physiologic changes result, causing any or all of the following pathophysiologic events:

- Increased intracranial pressure (ICP) and cerebral edema
- Seizure activity and focal neurologic signs
- Hydrocephalus
- Altered pituitary function

Neoplastic lesions in the brain ultimately cause death by increasing ICP and impairing vital functions, such as respiration.

According to the American Brain Tumor Association (ABTA, 2014), there are over 100 types of brain tumors with an estimated annual occurrence of 78,000 new cases. These include 25,000 malignant and 53,000 nonmalignant brain tumors (ABTA, 2014). Brain tumors are classified as primary or secondary. Primary brain tumors originate from cells within the brain. In adults, most primary brain tumors originate from glial cells (cells that make up the structure and support system of the brain and spinal cord) and are supratentorial (located above the covering of the cerebellum). Primary tumors progress locally and rarely metastasize outside the CNS.

Developed countries have a higher incidence of primary brain tumors, with rates of 5.1 per 100,000 compared to 3.0 per 100,000 in less developed countries. This is most likely due to more frequent diagnosis with improved imaging modalities. Although many risk factors have been investigated, exposure to ionizing radiation is the only known modifiable risk factor (American Association of Neuroscience Nurses [AANN], 2014a). Many genetic factors and genetic syndromes (such

as neurofibromatosis) are associated with brain tumor risk in families (AANN, 2014a).

Secondary, or metastatic, brain tumors develop from structures outside the brain and are twice as common as primary brain tumors (AANN, 2014a). Metastatic lesions to the brain can occur from the lung, breast, lower gastrointestinal tract, pancreas, kidney, and skin (melanomas) neoplasms. Single or multiple metastases may occur, and brain metastases may be found at any time during the disease course, even at initial diagnosis of the primary disease. Patient survival rates from primary brains cancers are improving, however, the incidence of brain metastases are increasing (AANN, 2014a); (Lovely, Stewart-Amidei, Page, et al., 2013).

The highest incidence of brain tumors in adults occurs in the fifth through seventh decades of life. There is a slight male predominance in the incidence of malignant brain tumors.

In India, prevalence of CNS tumor ranges from 5–10 per 100,000 population which accounts for 2% of malignancy (Nair, Varghese, & Swaminathan, 2015; Yeole, 2008).

It has been observed from the recent past that there is an increasing incidence rate of CNS tumor (Sarkar, Sharma, Deb, et al., 2005). Data of the year 2006 from Tata Memorial Hospital, Mumbai, have shown astrocytomas (38.7%) were the most common primary tumors with the majority being high-grade gliomas (59.5%) and rest were low-grade gliomas, 79 (33.1%) cases, where highest incidence was reported among adults in the age group of 19–40 years (Jalali & Datta, 2008).

Types of Primary Brain Tumors

Brain tumors may be classified into several groups: those arising from the coverings of the brain (e.g., dural meningioma), those developing in or on the cranial nerves (e.g., acoustic neuroma), those originating within brain tissue (e.g., glioma), and metastatic lesions originating elsewhere in the body. Tumors of the pituitary and pineal glands and of cerebral blood vessels are also types of brain tumors. Relevant clinical considerations include the location and the histologic character of the tumor. Tumors may be benign or malignant. A benign tumor, such as a colloid cyst, can occur in a vital area and can grow large enough to have serious effects (Hickey, 2014). See Chart 53-1 for the classification of brain tumors.

Chart 53-1

Classification of Brain Tumors in Adults

I. Intracerebral Tumors
   A. Gliomas—infiltrate any portion of the brain; most common type of brain tumor
      1. Astrocytomas (grades I and II)
      2. Glioblastoma (astrocytoma grades III and IV)
      3. Oligodendroglioma (low and high grades)
      4. Ependymoma (grades I to IV)
      5. Medulloblastoma
II. Tumors Arising From Supporting Structures
   A. Meningiomas
   B. Neuromas (acoustic neuroma, schwannoma)
   C. Pituitary adenomas
III. Developmental Tumors
   A. Angiomas
   B. Dermoid, epidermoid, teratoma, craniopharyngioma
IV. Metastatic Lesions

Gliomas

In adults, gliomas (principally astrocytoma) account for approximately 30% of symptomatic primary brain tumors. Glial tumors, the most common type of intracerebral brain neoplasm, are divided into many categories (Ostrom, Gittleman, Fulop, et al., 2015). Astrocytomas, arising from astrocytic cells, are the most common type of glioma and are graded from I to IV, indicating the degree of malignancy (ABTA, 2014). The grade is based on cellular density, cell mitosis, and degree of differentiation from the original cell type. Grades III and IV tumors are known as glioblastomas and have little resemblance to the original cell type. Astrocytomas infiltrate into the surrounding neural connective tissue and therefore cannot be totally removed without causing considerable damage to vital structures.

Oligodendroglial tumors, arising from oligodendroglial cells (about 4% of primary brain tumors) represent about 10% to 15% of the gliomas. Most oligodendrogliomas occur in adults ages 50 to 60, are found in men more often than in women, and are categorized as low or high grade (anaplastic) (ABTA, 2014). The histologic distinction between astrocytomas and oligodendrogliomas is difficult to make but is important, because oligodendrogliomas are more sensitive than astrocytomas to chemotherapy. Tumors originating from ependymal cells, another type of glial cell, are known as ependymomas and are more common in children than adults. Glial tumors may be treated with a combination of surgery, radiation therapy, and chemotherapy, depending on specific cell and patient characteristics.

Based on Indian Council for Medical Research hospital registry from 2004–2006, glioma incidence in Indian major cities revealed 3.5% in Chennai, 6.7% in Bangalore, 5.6% Dibrugarh, 5.8% in Mumbai, and 28.2% in Trivandrum among males and 5.6% in Bangalore, 7.5% in Chennai, 0% in Dibrugarh, 6.3% in Mumbai, and 21.8% in Trivandrum among females (Nandakumar & Ramnath, 2009).

Meningiomas

Meningiomas are common benign encapsulated tumors of arachnoid cells on the meninges (Ostrom et al., 2015). They are slow growing, occur most often in middle-aged adults, and are more common in women. Meningiomas most often occur in areas proximal to the venous sinuses. Manifestations depend on the area involved and are often the result of compression rather than invasion of brain tissue. Preferred treatment for symptomatic lesions is surgery with complete removal or partial dissection, although radiation therapy may be useful for some patients.

A Mumbai-based study reported that meningiomas account for 2.89% of brain tumors among all the patients diagnosed with brain tumors (Jalali & Datta, 2008).

Acoustic Neuromas

An acoustic neuroma is a tumor of the eighth cranial nerve—the cranial nerve most responsible for hearing and balance. It usually arises just within the internal auditory meatus, where it frequently expands before filling the cerebellopontine recess. An acoustic neuroma may grow slowly and attain considerable size before it is diagnosed. The patient usually experiences loss of hearing, tinnitus, and episodes of vertigo and staggering gait. As the tumor becomes larger, painful sensations of the face may occur on the same side as a result of the tumor's compression of

the fifth cranial nerve (ABTA, 2014). Many acoustic neuromas are benign and can be managed conservatively. Many that continue to grow can be surgically removed and have a good prognosis (see Chapter 41). Some acoustic neuromas may be suitable for stereotactic radiotherapy rather than open craniotomy. Stereotactic radiotherapy is discussed later in this chapter.

Pituitary Adenomas

Pituitary tumors account for about 16% of all primary brain tumors (ABTA, 2014). They can occur at any age, but they are more common in older adults. Women are affected more often than men, particularly during the childbearing years. Pituitary tumors are rarely malignant but cause symptoms as a result of pressure on adjacent structures or hormonal changes (ABTA, 2014).

However, Indian literature documented that pituitary adenoma accounts for 8.38% of all brain tumors. It is more common in 41–60 years of age group and men are affected more than women (Jalali & Datta, 2008).

Pressure Effects of Pituitary Adenomas

Pressure from a pituitary adenoma may be exerted on the optic nerves, optic chiasm, or optic tracts or on the hypothalamus or the third ventricle if the tumor invades the cavernous sinuses or expands into the sphenoid bone. These pressure effects produce headache, visual dysfunction, hypothalamic disorders (disorders of sleep, appetite, temperature, and emotions), increased ICP, and enlargement and erosion of the sella turcica.

Hormonal Effects of Pituitary Adenomas

Functioning pituitary tumors can produce one or more hormones normally produced by the anterior pituitary. Hormonal hypersecretion is caused only by pituitary adenomas. Most adenomas (65% to 70%) secrete an excess amount of hormone including prolactin (prolactinomas), growth hormone (GH) producing acromegaly in adults, adrenocorticotropic hormone (ACTH) resulting in Cushing syndrome, or thyroid-stimulating hormone (TSH) (Melmed, 2016). Adenomas that secrete TSH or follicle-stimulating hormone and luteinizing hormone occur infrequently, whereas adenomas that produce both GH and prolactin are relatively common.

The female patient whose pituitary gland is secreting excessive quantities of prolactin presents with amenorrhea or galactorrhea (excessive or spontaneous flow of milk). Male patients with prolactinomas may present with impotence and hypogonadism. Acromegaly, caused by excess GH, produces enlargement of the hands and feet, distortion of the facial features, and pressure on peripheral nerves (entrapment syndromes). The clinical features of Cushing syndrome, a condition associated with prolonged overproduction of cortisol, occur with excessive production of ACTH. Manifestations include a form of obesity with redistribution of fat to the facial, supraclavicular, and abdominal areas; hypertension; purple striae and ecchymoses; osteoporosis; elevated blood glucose levels; and emotional disorders. See Chapter 32 for a discussion of endocrine disorders resulting from these tumors.

Gerontologic Considerations

The most frequent tumor types in the older adult are anaplastic astrocytoma, glioblastoma, and cerebral metastases from other sites (Perkins & Liu, 2016). The incidence of all brain tumors increases with age. Intracranial tumors can produce personality changes, confusion, speech dysfunction, or disturbances of gait. In older adult patients, early signs and symptoms of intracranial tumors can be easily overlooked or incorrectly attributed to cognitive and neurologic changes associated with normal aging (Eliopoulos, 2018). Neurologic signs and symptoms in the older adult must be carefully evaluated, because brain metastases occur in patients with a history of prior cancer. Regardless of the age of the patient or the decision to proceed or not with treatment, the nurse provides supportive care. Researchers are investigating patterns of care and clinical outcomes of older adult patients with primary brain tumors (Gallego Perez-Larraya & Delattre, 2014).

Clinical Manifestations

Brain tumors can produce both focal or generalized neurologic signs and symptoms. Generalized symptoms reflect increased ICP, and the most common focal or specific signs and symptoms result from tumors that interfere with functions in specific brain regions. Figure 53-1 indicates common brain tumor sites.

Increased Intracranial Pressure

As discussed in Chapter 49, the skull is a rigid compartment containing essential noncompressible contents: brain matter, intravascular blood, and cerebrospinal fluid (CSF). The Monro-Kellie hypothesis or doctrine explains the dynamic equilibrium of the cranial contents. According to this hypothesis, if any one of these skull components increases in volume, ICP increases unless one of the other components decreases in volume. Consequently, any change in volume occupied by the brain (as occurs with disorders such as brain tumor or cerebral edema) produces signs and symptoms of increased ICP (Hickey, 2014).

The enlarging tumor and its associating edema disrupts the equilibrium between the brain, blood, and CSF. As the tumor grows, compensatory adjustments may occur through compression of intracranial veins, reduction of CSF volume (by increased absorption or decreased production), a modest decrease in cerebral blood flow, or reduction of intra- and extracellular brain tissue mass. When these compensatory mechanisms fail, the patient develops signs and symptoms of increased ICP, most often including headache, nausea with or without vomiting, and papilledema (swelling of the optic nerve) (Hickey, 2014). Personality changes and a variety of focal deficits, including motor, sensory, and cranial nerve dysfunction, are common.

Headache

Headache, although not always present, is most common in the early morning and is made worse by coughing, straining, or sudden movement. It is thought to be caused by the tumor invading, compressing, or distorting the pain-sensitive structures or by edema that accompanies the tumor. Headaches are usually described as deep, expanding, dull, but unrelenting. Frontal tumors usually produce a bilateral frontal headache; pituitary gland tumors produce pain radiating between the two temples (bitemporal); in cerebellar tumors, the headache may be located in the suboccipital region at the back of the head.

Vomiting

Vomiting, seldom related to food intake, is usually the result of irritation of the vagal centers in the medulla. Forceful vomiting is described as projectile vomiting. Headache may be relieved by vomiting.

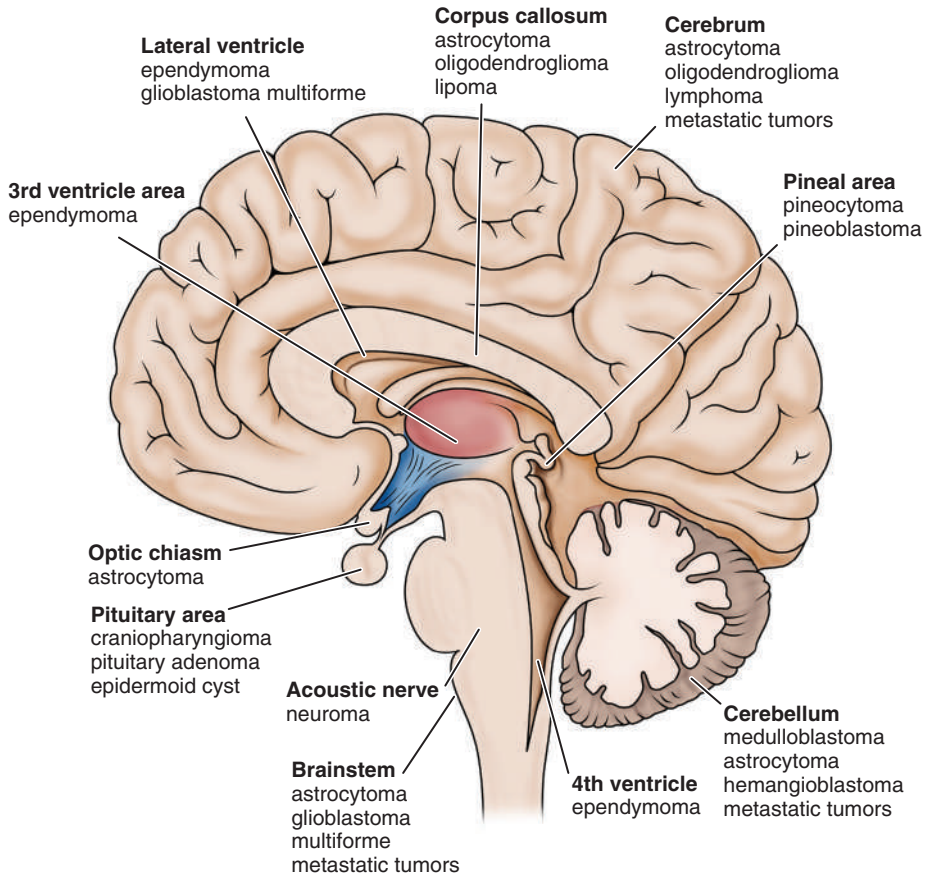


Figure 53-1 • Common brain tumor sites.

Visual Disturbances

The tumor itself or the surrounding edema can compress the third cranial nerve, causing optic disc swelling or papilledema. This limits the visual acuity along the visual pathway, mildly or profoundly, as diplopia (double vision), hemianopsia (visual field deficits), or varying levels of blindness (Rigi, Almarzbuqi, Morgan, et al., 2015).

Seizures

Seizures are common, occurring in 60% of patients with brain tumors either initially or throughout their disease process (AANN, 2014a). Seizures may be focal or generalized. Tumors of the frontal, parietal, and temporal lobes carry the greatest risk of seizures; seizures are unusual with brainstem or cerebellar tumors. See Chapter 49 for discussion about seizures and related management.

If not the initial presentation, seizures can be a result of metabolic factors (electrolyte imbalances, liver failure or kidney disease, radiation or chemotherapy side effects), structural causes (parenchymal metastases, leptomeningeal disease, dural metastases) or a new hemorrhage, thrombosis, or development of meningitis (Hickey, 2014). If the patient presents with a seizure, then anticonvulsant drugs are prescribed. Medications with the best evidence for controlling seizure activity include levetiracetam (Keppra), carbamazepine (Tegretol), phenytoin (Dilantin), and zonisamide (Zonegran) (Vecht, Kerkhof, & Duran-Pena, 2014).

Localized Symptoms

When specific regions of the brain are affected, local signs and symptoms occur, such as sensory or motor abnormalities, visual alterations, alterations in cognition, or language disturbances (e.g., aphasia). Identifying the signs and symptoms is important, because it can help identify tumor location. Some tumors are not easily localized because they lie in so-called silent areas of the brain (i.e., areas in which functions are not well defined). Many tumors can be localized by correlating the signs and symptoms to specific areas in the brain, as follows:

- A tumor in the motor cortex of the frontal lobe produces hemiparesis and partial seizures on the opposite side of the body or generalized seizures. A frontal lobe tumor may also produce changes in emotional state and behavior, as well as an apathetic mental attitude. The patient often becomes impulsive, inappropriate in speech, gestures, and behavior.
- A parietal lobe tumor may cause decreased sensation on the opposite side of the body or generalized seizures.
- A temporal lobe tumor may cause seizures as well as psychological disorders.
- An occipital lobe tumor produces visual manifestations: contralateral homonymous hemianopsia (visual loss in half of the visual field on the opposite side of the tumor) and visual hallucinations.
- A cerebellar tumor causes dizziness; an ataxic or staggering gait with a tendency to fall toward the side of the lesion; marked muscle incoordination; and nystagmus (involuntary rhythmic eye movements), usually in the horizontal direction.
- A cerebellopontine angle tumor usually originates in the sheath of the acoustic nerve and gives rise to a characteristic sequence of symptoms. Tinnitus and vertigo appear first,

soon followed by progressive nerve deafness (eighth cranial nerve dysfunction). Numbness and tingling of the face and tongue occur (due to involvement of the fifth cranial nerve). Later, weakness or paralysis of the face develops (seventh cranial nerve involvement). Finally, because the enlarging tumor presses on the cerebellum, abnormalities in motor function may be present.

- Brainstem tumors may be associated with cranial nerve deficits along with complex motor and sensory function impairments (Hickey, 2014).

Assessment and Diagnostic Findings

The history of the illness, the manner, and the time frame in which the symptoms evolved are key components in the diagnosis of brain tumors. A neurologic examination indicates the involved areas of the CNS. To assist in the precise localization of the lesion, a battery of tests is performed. Computed tomography (CT) scans, enhanced by a contrast agent, can give specific information concerning the number, size, and density of the lesions, and the extent of secondary cerebral edema. CT can provide information about the ventricular system. A magnetic resonance imaging (MRI) scan is the most helpful diagnostic tool for detecting brain tumors, particularly smaller lesions, and tumors in the brainstem and pituitary regions, where bone is thick (see Fig. 53-2). MRI is also useful in monitoring response to treatment.

Computer-assisted stereotactic (three-dimensional) biopsy is used to diagnose deep-seated brain tumors and to provide a basis for treatment and prognosis. Stereotactic approaches involve the use of a three-dimensional frame that allows very precise localization of the tumor; a stereotactic frame and multiple imaging studies (x-rays, CT scans, or MRIs) are used to localize the tumor and verify its position (see Fig. 53-3). Brain-mapping technology helps determine the proximity of diseased areas of the brain to structures essential for normal brain function.

Positron emission tomography (PET) is used to supplement MRI scanning in centers where it is available. On PET scans, low-grade tumors are associated with hypometabolism, and high-grade tumors show hypermetabolism. This information can be useful in making treatment decisions (AANN, 2014a). An electroencephalogram can detect abnormal brain waves in regions occupied by or adjacent to tumor; it is used to evaluate temporal lobe seizures and to assist in ruling out other disorders. Cytologic studies of the CSF may be performed to detect malignant cells as CNS tumors can shed cells into the CSF resulting in metastasis.

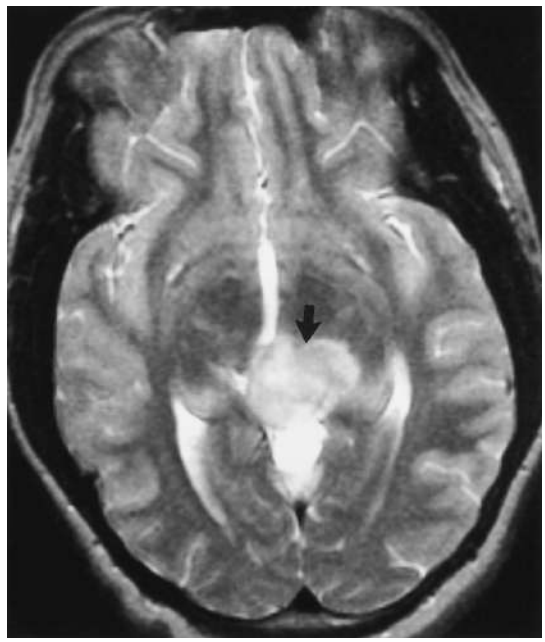


Figure 53-2 • Magnetic resonance image of the brain shows an exophytic tectal glioma (*arrow*) in this patient with neurofibromatosis type 1. From Brant, W. E., & Helms, C. A. (2006). Fundamentals of diagnostic radiology (3rd ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

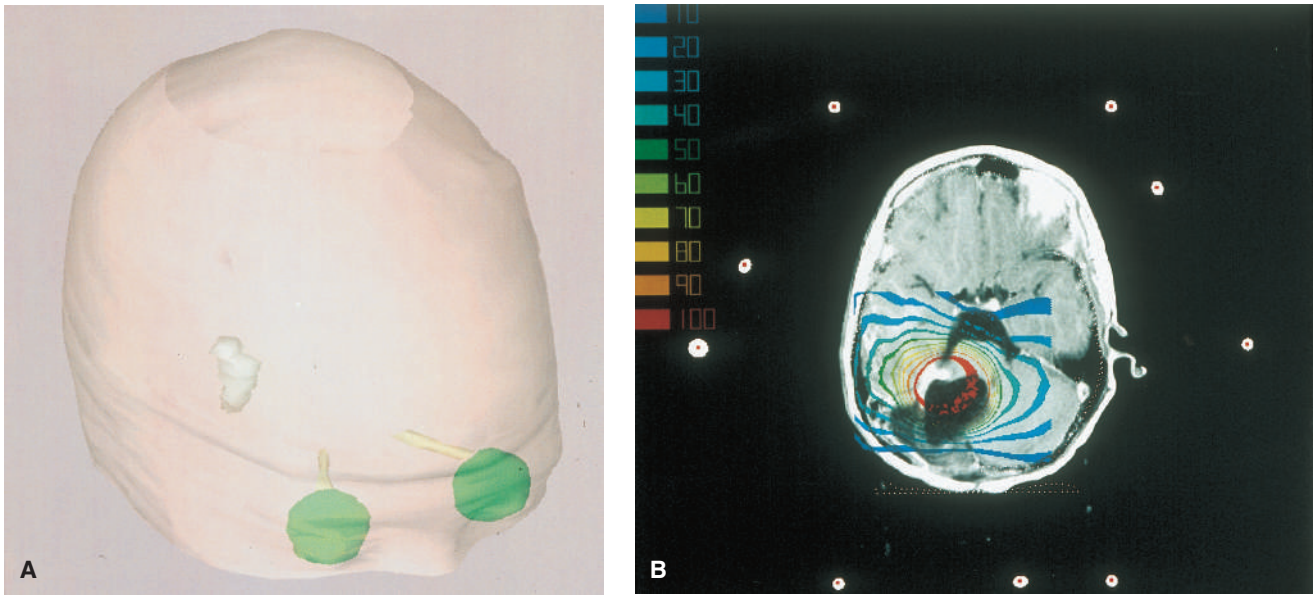


Figure 53-3 • **A.** Using stereotactic or "brain-mapping" guided approach, a three-dimensional computer image fuses the computed tomography image and magnetic resonance image to pinpoint the exact location of the brain tumor. This low-grade astrocytoma is localized adjacent to the brainstem, is inoperable, and is treated with radiation. Note the optic chasm and optic nerves. **B.** Computerized image of the prescribed radiation dose.

Medical Management

A variety of medical management approaches, including surgery, chemotherapy, and external-beam radiation therapy, are used alone or in combination (AANN, 2014a).

Secreting tumors may be treated with medications that suppress hormones. Nonfunctioning tumors may have no effect on pituitary function or may suppress hormone production and release. Hormone replacement may be necessary for these patients to restore normal endocrine function.

Surgical Management

The objective of surgical management is to remove as much tumor as possible without increasing the neurologic deficit (paralysis, blindness), or to relieve symptoms by partial removal (decompression). Surgery also provides tissue to establish a definitive diagnosis. A variety of surgical approaches may be used; the specific approach depends on the type of tumor, its location, and its accessibility. Conventional surgical approaches require a craniotomy (incision into the skull). See Chapter 49 for a discussion of care of the patient who has undergone a craniotomy. This approach is used in patients with meningiomas, acoustic neuromas, cystic astrocytomas of the cerebellum, colloid cysts of the third ventricle, congenital tumors such as dermoid cyst, and some of the granulomas. With improved imaging techniques and the availability of the operating microscope and microsurgical instrumentation, even large tumors can be removed through a relatively small craniotomy. For patients with malignant glioma, complete removal of the tumor and cure are not possible, but the rationale for resection includes relief of ICP, removal of any necrotic tissue, and reduction in the bulk of the tumor, which theoretically leaves behind fewer cells to become resistant to radiation or chemotherapy. Most pituitary adenomas are treated by transsphenoidal microsurgical removal (see Chapter 49), and the remainder of tumors that cannot be removed completely are treated by radiation (Hickey, 2014).

Radiation Therapy

Radiation therapy—the cornerstone of treatment for many brain tumors—decreases the incidence of recurrence of incompletely resected tumors (AANN, 2014a). Gamma radiation is delivered via an external beam to the tumor in multiple fractions. Brachytherapy (the surgical implantation of radiation sources to deliver high doses at a short distance) is an option for some types of tumors depending on their location. It is usually used as an adjunct to conventional radiation therapy or as a rescue measure for recurrent disease. Radioisotopes such as iodine 131 (^{131}I) are used to minimize effects on surrounding brain tissue.

Stereotactic procedures may be performed using a linear accelerator or gamma knife to perform radiosurgery (Hickey, 2014). These procedures allow treatment of deep, inaccessible tumors, often in a single session. Precise localization of the tumor is accomplished by the stereotactic approach and by minute measurements and precise positioning of the patient. Multiple narrow beams then deliver a very high dose of radiation. An advantage of this method is that no surgical incision is needed. Disadvantages include the lag time between treatment and the desired result as well as the potential for developing radiation necrosis (AANS, 2014a).

Chemotherapy

Chemotherapy may be used in conjunction with radiation therapy, or as the sole therapy, with the goal of increasing survival time. The greatest challenge in chemotherapy of brain tumors is that the blood–brain barrier prevents drugs from getting to the tumor in effective doses without causing systemic toxicity (AANN, 2014a).

Malignant glioma is usually treated with 6 weeks of oral temozolomide (Temodar) during radiation therapy, followed by 6 to 12 months of oral temozolomide. Low-grade gliomas may be treated with 6 months of oral temozolomide alone. Temozolomide is the first oral chemotherapy that crosses the blood–brain barrier (Hickey, 2014). Several other chemotherapy agents are used alone or in combination depending on the type of tumor (see Chapter 58)

Autologous bone marrow transplantation is used in some patients who will receive chemotherapy or radiation therapy, because it can "rescue" the patient from the bone marrow toxicity associated with high doses of chemotherapy and radiation. A fraction of the patient's bone marrow is aspirated, usually from the iliac crest, and stored. The patient receives large doses of chemotherapy or radiation therapy to destroy large numbers of malignant cells. The marrow is then reinfused intravenously after treatment is completed. See Chapter 28 for discussion of bone marrow transplant.

Pharmacologic Therapy

Corticosteroids are useful in relieving headache and alterations in level of consciousness. Corticosteroids such as dexamethasone (Decadron) are thought to reduce inflammation and edema around tumors (AANN, 2014a). Other medications used include osmotic diuretics (e.g., mannitol [Osmitrol] and hypertonic saline) to decrease the fluid content of the brain, which leads to a decrease in ICP. Anticonvulsant medications are used to treat and control seizures (Vecht et al., 2014). Venous thromboembolic events, such as deep vein thrombosis and pulmonary embolism, occur in about 15% of patients and are associated with significant morbidity. Patients receiving anticoagulant agents must be closely monitored because of the risk of CNS hemorrhage (Farge, 2013).

Nursing Management

Headache characteristics should be assessed. Upright positioning and pain medications may be useful in managing pain; nurses should evaluate effectiveness of pain management interventions. Even if seizure history is absent, the patient and family should be educated about the possibility of seizure and the need to adhere to prophylactic anticonvulsant medications, if prescribed. The patient with a brain tumor may be at increased risk for aspiration as a result of cranial nerve dysfunction. Medications to alleviate nausea and prevent vomiting should be considered. Preoperatively, the gag reflex and ability to swallow are evaluated. In patients with diminished gag response, care includes educating the patient to direct food and fluids toward the unaffected side, having the patient sit upright to eat, offering a semisoft diet, and having suction readily available. The effects of increased ICP caused by the tumor mass are reviewed in Chapter 49. The nurse performs neurologic checks; monitors vital signs; maintains a neurologic observation record (see Fig. 49-8 in Chapter 49); spaces nursing interventions to prevent rapid increase in ICP; and reorients the patient when necessary to person, time, and place. The use of corticosteroids to control headache and neurologic symptoms requires astute nursing assessment and intervention because many adverse effects can occur, including hyperglycemia,

electrolyte abnormalities, and muscle weakness (see Table 32-5 in Chapter 32). Patients with changes in cognition caused by their lesion require frequent reorientation and the use of orienting devices (e.g., personal possessions, photographs, lists, a clock), supervision of and assistance with self-care, and ongoing monitoring and intervention for prevention of injury. Patients with seizures are carefully monitored and protected from injury. Motor function is checked at intervals because specific motor deficits may occur, depending on the tumor's location. When muscle weakness is present, a multidisciplinary approach, including the nurse and physical and occupational therapists, can be used to preserve muscle strength, promote range of motion, and facilitate independence in self-care. Sensory disturbances are assessed and any area of numbness should be protected from injury. Speech is evaluated, and patients with speech deficits can be educated to use alternative forms of communication. Eye movement and pupillary size and reaction may be affected by cranial nerve involvement. Fatigue is common during therapy; efforts should be made to conserve energy and promote rest.

The psychosocial effects on family caregivers of a family member who has a primary malignant brain tumor may be significant (Dhandapani, Gupta, Dhandapani, et al., 2015). Caregiving family members should be included in the plan of care.

The nursing process for patients undergoing neurosurgery is discussed in Chapter 49. The patient's functional abilities should be reassessed postoperatively, because changes can occur.

Cerebral Metastases

A significant number of patients with cancer experience neurologic deficits caused by metastasis to the nervous system, which can include the brain, CSF, and meninges. Metastatic lesions to the brain are twice as common as primary brain tumors (Ostrom et al., 2015). This high rate of occurrence is clinically important, as more patients with all forms of cancer live longer because of improved therapies. Neurologic signs and symptoms include headache, gait disturbances, visual impairment, personality changes, altered mentation (memory loss and confusion), focal weakness, paralysis, aphasia, and seizures. These signs and symptoms can be devastating to both patient and family. Metastases to the CSF and meninges, known as leptomeningeal metastases, can produce symptoms of headache and isolated cranial nerve deficits.

Medical Management

The treatment of metastatic nervous system cancer is palliative and involves eliminating or reducing serious symptoms. Even when palliation is the goal, distressing signs and symptoms can be relieved, thereby improving the quality of life for both patient and family. Patients with intracerebral metastases who are not treated have a steady downhill course with a limited survival time. The therapeutic options include whole brain radiation therapy (the foundation of treatment) for multiple metastases or stereotactic radiosurgery for up to three sites of metastases. Surgery may be considered for a single symptomatic metastasis. Systemic chemotherapy directed at the primary cancer may be ineffective in crossing the blood–brain barrier, but chemotherapy that crosses this barrier may be added. Intrathecal chemotherapy, with direct injection of chemotherapy agents into the CSF of the brain or spinal canal, may be useful in persons with leptomeningeal metastases (Lukas, Buerke, & Mrugula, 2016). Some combination of these treatments is usually the optimal method.

Pain can be a significant problem and is managed by means of a stepped progression in the doses and type of analgesic agents needed for relief. If the patient has severe pain, morphine can be infused into the epidural or subarachnoid space through a spinal needle and a catheter placed as near as possible to the spinal segment where the pain is projected. Small doses of morphine are given at prescribed intervals (see Chapter 9).

NURSING PROCESS

The Patient with Nervous System Metastases or Primary Brain Tumor

Assessment

The nursing assessment includes a baseline neurologic examination and focuses on how the patient is functioning, moving, and walking; adapting to weakness or paralysis and to loss of vision and speech; and dealing with seizures. Assessment addresses symptoms that cause distress to the patient and affect the quality of life, including pain, respiratory problems, bowel and bladder disorders, and sleep disturbances, as well as impairment of skin integrity, fluid balance, and temperature regulation (Hickey, 2014). Nutritional status is assessed, because cachexia and cancer-related anorexia-cachexia syndrome are common (see Chapter 58).

The nurse takes a dietary history to assess food intake, intolerance, and preferences. Calculation of body mass index can confirm the loss of subcutaneous fat and lean body mass (see Chapter 3). Biochemical measurements are reviewed to assess the degree of malnutrition, impaired cellular immunity, and electrolyte balance (normal laboratory values are found in Appendix A). A dietitian assists in determining the caloric needs of the patient.

The nurse works with other members of the health care team to assess the impact of the illness on the family in terms of home care, altered relationships, financial problems, time pressures, and family problems. This information is important in helping family members cope with the diagnosis and the changes associated with it.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Self-care deficit (feeding, bathing, and toileting) related to loss or impairment of motor and sensory functions and decreased cognitive abilities
- Imbalanced nutrition: less than body requirements related to cachexia due to treatment and tumor effects, decreased nutritional intake, and malabsorption
- Imbalanced nutrition: more than body requirements related to increased nutritional intake and impaired metabolism
- Anxiety related to fear of dying, uncertainty, change in appearance, or altered lifestyle
- Interrupted family processes related to anticipatory grief and the burdens imposed by the care of the person with a terminal illness

Other nursing diagnoses of the patient with nervous system metastases may include acute pain related to tumor compression; impaired gas exchange related to dyspnea; constipation related to decreased fluid and dietary intake and medications; impaired urinary elimination related to reduced fluid intake, vomiting, and side effects of medications; sleep pattern disturbances related to discomfort and fear of dying; impairment of skin integrity related to cachexia, poor tissue perfusion, and decreased mobility; deficient fluid volume related to fever, vomiting, and low fluid intake; and ineffective thermoregulation related to hypothalamic involvement, fever, and chills. See Chapter 58 for assessment and nursing interventions for the patient with cancer.

Planning and Goals

The goals for the patient include compensating for self-care deficits, improving nutrition, reducing anxiety, enhancing family coping skills, and absence of complications.

Nursing Interventions

Compensating for Self-Care Deficits

The patient may have difficulty participating in goal setting as the tumor metastasizes and affects cognitive function. The nurse should encourage the family to keep the patient as independent as possible for as long as possible (AANN, 2014a). Increasing assistance with self-care activities is to be expected. Because the patient with nervous system metastasis and the family live with uncertainty, they are encouraged to plan for each day and to make the most of each day. The tasks and challenges are to assist the patient to find useful coping mechanisms, adaptations, and compensations for solving problems that arise. This helps patients maintain some sense of control. An individualized exercise program helps maintain strength, endurance, and range of motion. Eventually, referral for home or hospice care may be necessary (see Chapter 59).

Improving Nutrition

Patients with nausea, vomiting, diarrhea, breathlessness, and pain are rarely interested in eating. These symptoms are managed or controlled through assessment, planning, and care. The nurse educates the family about how to position the patient for comfort and safety during meals. A dietician may help with alternative food choices that are easily tolerated. Meals are planned for times when the patient is rested and in less distress from pain or the effects of treatment.

The patient needs to be clean, comfortable, and free of pain for meals, in an environment that is as attractive as possible. Oral hygiene before meals helps to improve appetite. Offensive sights, sounds, and odors are eliminated. Creative strategies may be required to make food more palatable, provide enough fluids, and increase opportunities for socialization during meals. The family may be asked to keep a log of daily weights and to record the quantity of food eaten to determine the daily calorie count. Dietary supplements, if acceptable to the patient, can be provided to meet increased caloric needs. If the patient is not interested in most usual foods, those foods preferred by the patient should be offered. When the patient shows marked deterioration as a result of tumor growth and effects, some other form of nutritional support (e.g., tube feeding, parenteral nutrition) may be indicated if consistent with the patient's end-of-life preferences (AANN, 2014a). Nursing interventions include assessing the patency of the central and intravenous lines or feeding tube, monitoring the insertion site for infection, checking the infusion rate, monitoring intake and output, and changing the intravenous tubing and dressing. Family members are instructed in these techniques if they will be providing care at home. Parenteral nutrition can be provided at home if indicated. The patient's quality of life may guide the selection, initiation, maintenance, and discontinuation of nutritional support. The nurse and family should not place too much emphasis on eating or on discussions about food, because the patient may not desire aggressive nutritional intervention. The subsequent course of action must be congruent with the wishes and choices of the patient and family.

Increased appetite may occur in patients receiving steroids and may result in weight gain as well as hyperglycemia. Patients and family members should be instructed to monitor weight and blood glucose (if appropriate), as well as maintain a healthy diet with caloric intake appropriate to patient needs.

Relieving Anxiety

Patients may be restless, with changing moods that may include intense depression, euphoria, paranoia, and severe anxiety. The response of patients to terminal illness reflects their pattern of reaction to other crisis situations. Serious illness imposes additional strains that often bring other unresolved problems to light. The patient's own coping strategies can help deal with anxious and depressed feelings. Health care providers need to be sensitive to the patient's concerns and fears.

Patients need the opportunity to exercise some control over their situation. A sense of mastery can be gained as they learn to understand the disease and its treatment and how to deal with their feelings. The presence of family, friends, a spiritual advisor, and health professionals may be supportive. Brain tumor support groups may provide a feeling of support and strength (see the Resources section).

Spending time with patients allows them time to talk and to communicate their fears and concerns. Open communication and acknowledgment of fears are often therapeutic. Touch is also a form of communication. These patients need reassurance that continuing care will be provided and that they will not be abandoned. The situation becomes more endurable when others share in the experience of dying. If a patient's emotional reactions are very intense or prolonged, additional help from a spiritual advisor, social worker, or mental health professional may be indicated.

Enhancing Family Processes

The family needs to be reassured that their loved one is receiving optimal care and that attention will be paid to the patient's changing symptoms and concerns. When the patient can no longer carry out self-care, the family and additional support systems (social worker, home health aide, home care nurse, hospice nurse) may be needed. Educating family members on how to care for their loved one with additional physical, cognitive, and maybe behavioral impairments is necessary, acute, and challenging. Investigating what supportive and financial resources are available may decrease the burden on the caregivers. These efforts improve quality of life for the patient and family (Dhandapani et al., 2015).

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. The patient and family often have major responsibility for care at home. Caregivers

Chart 53-2 HOME CARE CHECKLIST

The Patient with Nervous System Metastases

At the completion of education, the patient and/or caregiver will be able to:

- State effects of the tumor according to its type and location in the brain or spinal cord.
- State the impact of the tumor and treatment on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
  - Describe goals and side effects of treatment and suggested management approaches.
- State the name, dose, side effects, frequency, and schedule for all medications.
  - When indicated, use nonpharmacologic pain management techniques in addition to prescribed pharmacologic methods.
- State how to contact all members of the treatment team (e.g., health care providers, home care professionals, and durable medical equipment and supply vendor).
- State changes in lifestyle (e.g., nutritional needs, ADL assistance) necessary to maintain health.
- Identify coping strategies, such as:
  - Taking control, setting daily goals, and staying positive.
  - Rehabilitation to improve self-care.
  - Relaxation techniques.
  - Family support.
  - Support groups.
- Identify community resources, including palliative care, home health service, hospice, as appropriate.
- List complications of medications/therapeutic regimen necessitating a call to the nurse or primary provider.
- List complications of medications/therapeutic regimen necessitating a visit to the emergency department.
- Relate how to reach primary provider with questions or complications.
- State time and date of follow-up medical appointments, therapy, and testing.

Resources

See Chapter 58, Chart 58-10 Home Care Checklist: The Client Undergoing Care for an Oncologic Disorder.

ADL, activities of daily living; IADL, independent activities of daily living.

may struggle with a new "normal" while their support systems fluctuate as their relationship with the patient they are caring for is strengthened, maintained, or strained (Ownsworth, Goadby, & Chambers, 2015). In addition to the psychological aspect, education includes pain management strategies, prevention of complications related to treatment strategies, and methods to ensure adequate fluid and food intake (see Chart 53-2). Educational needs of the patient and family regarding care priorities are likely to change as the disease progresses. The nurse should assess the changing needs of the patient and the family and inform them about resources and services early and frequently to assist them in dealing with changes in the patient's condition (see the Resources section).

Continuing and Transitional Care. Home care nursing and hospice services are valuable resources that should be made available to the patient and the family early in the course of a terminal illness. Anticipating needs before they occur can assist in smooth initiation of services. Home care needs and interventions focus on four major areas: palliation of symptoms and pain control, assistance in self-care, control of treatment complications, and administration of specific forms of treatment (e.g., parenteral nutrition). The nurse assesses pain management, respiratory status, complications of the disorder and its treatment, and the patient's cognitive and emotional status. In addition, the nurse assesses the family's ability to perform necessary care and notifies the primary provider about changing needs or complications, if indicated.

The patient and family who elect to care for the patient at home as the disease progresses can benefit from the care and support provided through hospice and palliative care services (Ownsworth et al., 2015). Steps to initiate hospice care, including discussion of hospice care as an option, should not be postponed until death is imminent. Exploration of hospice care as an option should be initiated at a time when hospice services can provide support and care to the patient and family consistent with their end-of-life decisions and can assist in allowing death with dignity. See Chapter 59 for in-depth discussion of end-of-life care.

Evaluation

Expected patient outcomes may include:

1. Engages in self-care activities as long as possible
   a. Uses assistive devices or accepts assistance as needed
   b. Schedules periodic rest periods to permit maximal participation in self-care
2. Maintains as optimal a nutritional status as possible
   a. Eats and accepts food within limits of condition and preferences
   b. Accepts alternative methods of providing nutrition if indicated
3. Reports being less anxious
   a. Is less restless and is sleeping better
   b. Verbalizes concerns and fears about death
   c. Participates in activities of personal importance as long as feasible
4. Family members seek help as needed
   a. Demonstrate ability to bathe, feed, and care for the patient and participate in pain management and prevention of complications
   b. Express feelings and concerns to appropriate health professionals
   c. Discuss and seek hospice care as an option

Spinal Cord Tumors

Tumors within the spinal canal are classified according to their anatomic relation to the spinal cord (Bader, Littlejohns, Olson, et al., 2016). They include intramedullary lesions (within the spinal cord), extramedullary-intradural lesions (within or under the spinal dura), and extramedullary-extradural lesions (outside the dural membrane). Primary tumors are usually intramedullary, consisting of astrocytoma or ependymoma; meningiomas can occur as extramedullary-intradural lesions. Secondary tumors are far more common and are usually extramedullary-extradural lesions. Tumors that occur within the spinal canal or exert pressure on it cause symptoms ranging

from localized or shooting pains, weakness and loss of reflexes below the tumor level to progressive loss of motor function and paralysis. Usually, sharp pain occurs in the area innervated by the spinal roots that arise from the cord in the region of the tumor. In addition, increasing sensory deficits develop below the level of the lesion. Loss of bowel and bladder function is common.

Bhat et al. (2016) reported that the incidence rate of spinal cord and bone primary and metastatic tumors in Jammu and Kashmir, India, was about 0.24 per 100,000 population per year for all ages. Among children (≤18 years) it was 0.014 per 100,000 persons per year. Furthermore, it was reported that the occurrence of spinal cord tumor was more among males than females and these were mostly found in fourth and fifth decades whereas intradural intramedullary tumors were seen in third and fourth decades and mostly in males.

Assessment and Diagnostic Findings

Neurologic examination and diagnostic studies are used to make the diagnosis. Neurologic examination focuses on assessing pain and identifying loss of reflexes, sensation, or motor function. Helpful diagnostic studies include CT scans, MRI scans, and biopsy. The MRI scan is the most commonly used and the most sensitive diagnostic tool (Hickey, 2014) and it is particularly helpful in detecting epidural spinal cord compression and metastases.

Medical Management

Treatment of specific intraspinal tumors depends on the type and location of the tumor and the presenting symptoms and physical status of the patient. Surgical intervention is the primary treatment for most spinal cord tumors followed by chemotherapy and radiation therapy. Research is ongoing with direct, localized drug delivery and nanomedicine treatment (Tobin, Geraghty, Engelhard, et al., 2015).

Extramedullary-extradural spinal cord compression occurs in 5% to 7% of patients who die of cancer and is considered a neurologic emergency. For the patient with spinal cord compression resulting from metastatic cancer (most commonly from breast, prostate, or lung), high-dose dexamethasone (Decadron) combined with radiation therapy is effective in relieving pain (see Chapter 51 for a discussion of care of the patient with spinal cord compression). Palliative care may be an option for the medical management of some patients. Chemotherapy specific to the tumor type may be considered (Perkins & Liu, 2016).

Surgical Management

Tumor removal is desirable but not always possible. The goal is to remove as much tumor as possible while sparing uninvolved portions of the spinal cord. Sudden decrease or loss of motor, sensory, and bowel and bladder function indicates the need for emergent surgery to reestablish function and protect the cord from further damage (Hickey, 2014). Microsurgical techniques have improved the prognosis for patients with intramedullary tumors. Extramedullary-intradural tumors may be completely resected. Prognosis is related to the degree of neurologic impairment at the time of surgery, the speed with which symptoms occurred, and the origin of the tumor. Patients with extensive neurologic deficits before surgery are less likely to regain full functional recovery after successful tumor removal.

Nursing Management

Providing Preoperative Care

The objectives of preoperative care include recognition of neurologic changes through ongoing assessments, pain control, and management of altered activities of daily living (ADLs) resulting from sensory and motor deficits and bowel and bladder dysfunction. The nurse assesses for weakness, muscle wasting, spasticity, sensory changes, bowel and bladder dysfunction, and potential respiratory problems, especially if a cervical tumor is present. The patient is also evaluated for coagulation deficiencies. A history of anticoagulation medication use is obtained and reported, because the use of these may impede hemostasis postoperatively. The patient is educated about breathing exercises, and they are demonstrated preoperatively. Postoperative pain management strategies are discussed with the patient before surgery.

Assessing the Patient After Surgery

The patient is monitored for deterioration in neurologic status. A sudden onset of neurologic deficit is an ominous sign and may be due to spinal cord ischemia or infarction. Frequent neurologic checks are carried out, with emphasis on movement, strength, and sensation of the upper and lower extremities. Assessment of sensory function involves pinching the skin of the arms, legs, and trunk to determine if there is loss of feeling and, if so, at what level. Vital signs are monitored at regular intervals.

Managing Pain

The prescribed pain medication should be given in adequate amounts and at appropriate intervals to relieve pain and prevent its recurrence. Pain is the hallmark of spinal metastasis. Patients with sensory root involvement may suffer excruciating pain, which requires effective pain management.

The bed is usually kept flat initially. The nurse turns the patient as a unit, keeping shoulders and hips aligned and the back straight (also referred to as logrolling) (see Fig. 53-12). The side-lying position is usually the most comfortable, because this position imposes the least pressure on the surgical site. Placement of a pillow between the knees of the patient in a side-lying position helps to prevent extreme knee flexion.

Monitoring and Managing Potential Complications

If the tumor was in the cervical area, respiratory compromise due to postoperative edema may occur (Marchetti, 2014). The nurse monitors the patient for asymmetric chest movement, abdominal breathing, and abnormal breath sounds. For a high cervical lesion, the endotracheal tube remains in place until adequate respiratory function is ensured. The patient is encouraged to perform deep-breathing and coughing exercises.

The area over the bladder is palpated or a bladder scan performed to assess for urinary retention. The nurse also monitors for incontinence, because urinary dysfunction usually implies significant decompensation of spinal cord function. An intake and output record is maintained. In addition, the abdomen is auscultated for bowel sounds.

Staining of the dressing may indicate leakage of CSF from the surgical site, which may lead to serious infection or to an inflammatory reaction in the surrounding tissues that can cause severe pain in the postoperative period. Bulging at the incision may indicate contained CSF leak. The site should be monitored for increasing bulging, known as pseudomeningocele, which may require surgical repair (Hickey, 2014).

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

In preparation for discharge, the patient is assessed for the ability to function independently in the home and for the availability of resources such as family members to assist in caregiving. Patients with residual sensory involvement are cautioned about the dangers of extremes in temperature. They should be educated about the dangers of heating devices (e.g., hot water bottles, heating pads, space heaters) as their sensory integration may be impaired, causing them to lose the ability to detect dangerous stimulations and to react appropriately. The patient is educated to check skin integrity daily. Patients with impaired motor function related to motor weakness or paralysis may require training in ADLs and safe use of assistive devices, such as a cane, walker, or wheelchair (see Chapter 38). The patient and family members are educated about pain management strategies, bowel and bladder management, and assessment for signs and symptoms that should be reported promptly (see Chart 53-2).

Continuing and Transitional Care

Referral for inpatient or outpatient rehabilitation may be warranted to improve self-care abilities. A consultation for home, community-based or transitional care may be indicated and provides the nurse with the opportunity to assess the patient's physical and psychological status and the patient's and family's ability to adhere to recommended management strategies. During the home visit, the nurse determines whether changes in neurologic function have occurred. The patient's respiratory status and nutritional status are assessed. The adequacy of pain management is assessed, and modifications are made to ensure adequate pain relief. The need for hospice services or placement in an extended care facility is discussed with the patient and family if warranted, and the patient is asked about preferences for end-of-life care. In addition, social workers may be consulted to assist the patient and family members in identifying support groups and agencies that can provide help in coping with the disease process (Hickey, 2014).

DEGENERATIVE DISORDERS

Disorders of the central and peripheral nervous system that are neurodegenerative (leading to deterioration of normal cells or function of the nervous system) are characterized by the slow onset of signs and symptoms. Patients are managed at home for as long as possible and are admitted to the acute care setting for exacerbations, treatments, and surgical interventions as needed.

Alzheimer Disease

AD, the sixth leading cause of death for older adults, is a progressive, irreversible, degenerative neurologic disease that begins insidiously and is characterized by gradual losses of cognitive function and disturbances in behavior and affect. AD can occur in people as young as 40 years of age but is uncommon before 65 years of age. Although the prevalence of AD increases dramatically with increasing age, affecting as many as half of those 85 years and older, AD is not a normal part of aging. Without a cure or any preventive measures, it is estimated that 13.4 million Americans will have this disease by 2050 (Kochanek, Murphy, Xu, et al., 2014); (Weuve, Hebert, Scherr, et al., 2014).

There are numerous theories about the cause of age-related cognitive decline. Although the greatest risk factor for AD is increasing age, many environmental, dietary, and inflammatory factors also may determine whether a person suffers from this cognitive disease. AD is a complex brain disorder caused by a combination of various factors that may include genetics, neurotransmitter changes, vascular abnormalities, stress hormones, circadian changes, head trauma, and the presence of seizure disorders.

AD can be classified into two types: familial or early-onset AD and sporadic or late-onset AD. Familial AD is rare, accounting for less than 1% of all cases, and is frequently associated with genetic mutations (Sherva & Kowall, 2015). It can occur in middle-aged adults. If family members have at least one other relative with AD, then there is a familial component, which may include both environmental triggers and genetic determinants.

Pathophysiology

The pathogenesis of AD is uncertain but the disease includes specific neuropathologic and biochemical changes that interfere with neurotransmission. These changes consist of neurofibrillary tangles (tangled masses of nonfunctioning neurons) and senile or neuritic plaques (deposits of amyloid protein, part of a larger protein called *amyloid precursor protein* in the brain) (see Fig. 53-4). The neuronal damage occurs primarily in the cerebral cortex and results in decreased brain size. Similar changes are found in the normal brain tissue of nonsymptomatic older adults, although to a lesser extent. Cells that use the neurotransmitter acetylcholine are principally affected by AD. At the biochemical level, the enzyme active in producing acetylcholine, which is specifically involved in memory processing, is decreased.

Scientists have been studying complex neurodegenerative diseases such as AD and have focused on two key issues: whether a gene might influence a person's overall risk of developing the disease, and whether a gene might influence some particular aspect of a person's risk, such as the age at which the disease begins (age at onset). There are genetic differences in early- and late-onset forms of AD (Sherva & Kowall, 2015). Researchers are investigating what predisposes people to develop the plaques and neurofibrillary tangles that can be seen at autopsy in the brains of patients with AD. Understanding the complex ways in which aging as well as genetic and nongenetic factors affect brain cells over time, eventually leading to AD, continues to increase.

Clinical Manifestations

In the early stages of AD, forgetfulness and subtle memory loss occur. Patients may experience small difficulties in work or social activities but have adequate cognitive function to compensate for the loss and continue to function independently. With further progression of AD, the deficits can no longer be concealed. Forgetfulness is manifested in many daily actions; patients may lose their ability to recognize familiar faces, places, and objects and they may become lost in a familiar environment. They may repeat the same stories or ask the same question repeatedly. Trying to reason with people with AD and using reality orientation only increase their anxiety without increasing function. Conversation becomes difficult, and word-finding difficulties occur. The ability to formulate concepts and

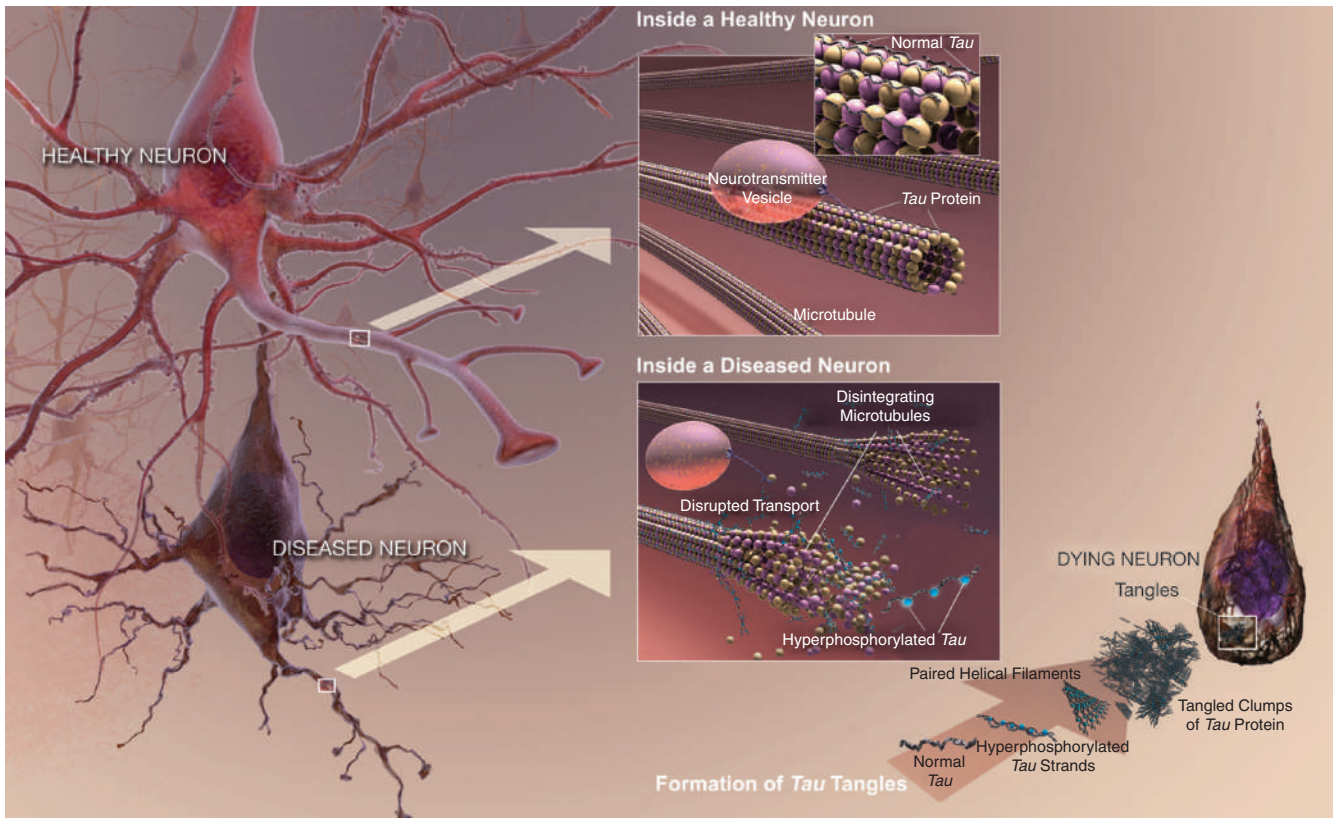


Figure 53-4 • Healthy and diseased neurons and formation of tau tangles. From National Institute on Aging, National Institutes of Health, Alzheimer's Disease Education and Referral Center. Retrieved at: www.nia.nih.gov/alzheimers/scientific-images.

think abstractly disappears—for example, a patient can interpret a proverb only in concrete terms. Patients are often unable to recognize the consequences of their actions and, therefore, exhibit impulsive behavior—for example, on a hot day a patient may decide to wade in the city fountain fully clothed. Patients have difficulty with everyday activities, such as operating simple appliances and handling money.

Personality changes are also usually evident. Patients may become depressed, suspicious, paranoid, hostile, and even combative. Progression of the disease intensifies the symptoms: Speaking skills deteriorate to nonsense syllables, agitation and physical activity increase, and patients may wander at night. Eventually, assistance is needed for most ADLs, including eating and toileting, because dysphagia and incontinence develop. The terminal stage, in which patients are usually immobile and require total care, may last months or years. Occasionally, patients may recognize family members or caregivers. Death occurs as a result of complications such as pneumonia, malnutrition, or dehydration.

Assessment and Diagnostic Findings

A definitive diagnosis of AD can be made only at autopsy; however, an accurate clinical diagnosis can be made in the majority of cases. The most important goal is to rule out other causes of dementia that are reversible, such as depression, delirium, alcohol or drug abuse, or inappropriate drug dosage or drug toxicity. AD is a diagnosis of exclusion; a diagnosis of probable AD is made when the medical history, physical examination, and laboratory tests have excluded all known causes of other dementias.

The health history—including medical history, family history, social and cultural history, and medication history—and the physical examination, including functional and mental health status, are essential to the diagnosis of probable AD. Diagnostic tests, including complete blood count, chemistry profile, and vitamin B_{12} and thyroid hormone levels, as well as screening with electroencephalography, computed tomography (CT), magnetic resonance imaging (MRI), and examination of the cerebrospinal fluid, may all refute or support a diagnosis of probable AD.

Depression can closely mimic early-stage AD and coexists in many patients. Therefore, assessing the patient for underlying depression is important. The GDS is a useful tool to assess for depression (see chapter 62, Chart 62-6). Tools such as the MMSE (see Chart 62-3) are useful for assessing cognitive status and screening for AD. Both CT and MRI of the brain are useful for excluding hematoma, brain tumor, stroke, normal-pressure hydrocephalus, and atrophy but are not reliable in making a definitive diagnosis of AD. Infections and physiologic disturbances, such as hypothyroidism, Parkinson disease, and vitamin B_{12} deficiency, can cause cognitive impairment that may be misdiagnosed as AD. Biochemical abnormalities can be excluded through examination of the blood and cerebrospinal fluid.

Medical Management

In AD, the primary goal is to manage the cognitive and behavioral symptoms. Although there is no cure, several medications slow the progression of the disease. Cholinesterase inhibitors donepezil hydrochloride (Aricept) and rivastigmine tartrate (Exelon), for example, enhance acetylcholine uptake

in the brain, thus maintaining memory skills for a period of time. Cognitive ability may improve within 6 to 12 months of therapy. Rivastigmine (Exelon Patch) is indicated for severe AD; It is recommended that treatment continue as long as possible (Comerford, 2015).

Behavioral problems such as agitation and psychosis can be managed by behavioral and psychosocial therapies. Associated depression and behavioral problems can also be treated pharmacologically if other interventions fail. Because symptoms change over time, all patients with AD should be reevaluated routinely, and the nurse should document and report both positive and negative responses to medications (Miller, 2015).

Nursing Management

Nurses play an important role in the recognition of dementia, particularly in hospitalized older adults, by assessing for signs (e.g., repeating or asking the same thing over and over). Nursing interventions for dementia are aimed at promoting patient function and independence for as long as possible. Other important goals include promoting the patient's physical safety, promoting independence in self-care activities, reducing anxiety and agitation, improving communication, providing for socialization and intimacy, promoting adequate nutrition, promoting balanced activity and rest, and supporting and educating family caregivers. These nursing interventions apply to all patients with dementia, regardless of cause.

Supporting Cognitive Function

Because dementia of any type is degenerative and progressive, patients display a decline in cognitive function over time. In the early phase of dementia, minimal cuing and guidance may be all that are needed for the patient to function fairly independently for a number of years. However, as the patient's cognitive ability declines, family members must provide more and more assistance and supervision. A calm, predictable environment helps people with dementia interpret their surroundings and activities. Environmental stimuli are limited, and a regular routine is established. A quiet, pleasant manner of speaking, clear and simple explanations, and the use of memory aids and cues help minimize confusion and disorientation and give patients a sense of security. Prominently displayed clocks and calendars may enhance orientation to time. Color-coding the doorway may help patients who have difficulty locating their room. Active participation may help patients maintain cognitive, functional, and social interaction abilities for a longer period. Physical activity and communication have also been demonstrated to slow some of the cognitive decline of AD.

Promoting Physical Safety

A safe home and hospital environment allows the patient to move about as freely as possible and relieves the family of constant worry about safety. For the patient residing at home, in order to prevent falls and other injuries, all obvious hazards are removed and hand rails are installed. A hazard-free environment allows the patient maximum independence and a sense of autonomy. Adequate lighting, especially in halls, stairs, and bathrooms, is necessary. Nightlights are helpful, particularly if the patient has increased confusion at night, sometimes referred to as sundowning. Driving is prohibited, and smoking is allowed only with supervision. The patient may have a short attention span and be forgetful; therefore, the nurse and the family must be patient, repeat instructions as needed, and use reminders (i.e., post-it notes, electronic reminders) for daily activities. Doors leading from the house must be secured. Outside the home, all activities must be supervised to protect the patient, and the patient should wear some type of identification in case of separation from the caregiver.

If the patient is hospitalized, additional precautionary measures should be taken. Wandering behavior, which may be worse in the hospital due to unfamiliar surroundings, can often be reduced by gentle persuasion, distraction, or by placing the patient close to the nursing station. Restraints should be avoided because they can increase agitation and lead to injury.

Promoting Independence in Self-Care Activities

Pathophysiologic changes in the brain make it difficult for people with AD to maintain physical independence. Patients should be assisted to remain functionally independent for as long as possible. One way to do this is to simplify daily activities by organizing them into short, achievable steps so that the patient experiences a sense of accomplishment. Frequently, occupational therapists can suggest ways to simplify tasks or recommend adaptive equipment. Direct patient supervision is sometimes necessary; however, maintaining personal dignity and autonomy is important for people with AD, who should be encouraged to make choices when appropriate and to participate in self-care activities as much as possible.

Reducing Anxiety and Agitation

Despite profound cognitive losses, patients are sometimes aware of their diminishing abilities. Patients need constant emotional support that reinforces a positive self-image. When loss of skills occurs, goals are adjusted to fit the patient's declining ability.

The environment should be kept familiar and noise free. Excitement and confusion can be upsetting and may precipitate a combative, agitated state known as a catastrophic reaction (overreaction to excessive stimulation). The patient may respond by screaming, crying, or becoming abusive (physically or verbally); this may be the patient's only way of expressing an inability to cope with the environment. When this occurs, it is important to remain calm and unhurried. Forcing the patient to proceed with the activity only increases the agitation. It is better to postpone the activity until later, even to another day. Frequently, the patient quickly forgets what triggered the reaction. Measures such as moving to a familiar environment, listening to music, stroking, rocking, or distraction may quiet the patient. Research suggests that the use of activities and music therapy, both individualized and in groups, help decrease agitation (Chang, Chu, Yang, et al., 2015); (Livingston, Kelly, Lewis-Holmes, et al., 2014). Becoming familiar with a particular patient's usual responses to certain stressors helps caregivers avoid stressful situations.

Patients with dementia who have progressed to the late stages of the disease often reside in nursing homes and are predominantly cared for by unlicensed assistive personnel. One systematic review found that training all staff in communication, person-centered care skills, or dementia care mapping are clinically important interventions that decreased agitation by 30% in long-term care (Livingston et al., 2014). Another study of nursing home residents with dementia suggested that adequately treating pain could reduce both physical and verbal aggression (Ahn, Garvan, & Lyon, 2015). Education for family members and caregivers is essential to minimize patient agitation and can be effectively taught by geriatric advanced nurse practitioners (Gies et al., 2014).

Improving Communication

To promote the patient's interpretation of messages, the nurse should remain unhurried and reduce noises and distractions. Use of clear, easy-to-understand sentences to convey messages is essential because patients frequently forget the meaning of words or have difficulty organizing and expressing thoughts. In the earlier stages of dementia, lists and simple written instructions that serve as reminders may be helpful. In later stages, the patient may be able to point to an object or use nonverbal language to communicate. Tactile stimuli, such as hugs or hand pats, are usually interpreted as signs of affection, concern, and security.

Providing for Socialization and Intimacy Needs

Because socialization with friends can be comforting, visits, letters, and phone calls are encouraged. Recreation is important, and people with dementia are encouraged to participate in simple activities. Realistic goals for activities that provide satisfaction are appropriate. Hobbies and activities such as walking, exercising, and socializing can improve quality of life. The nonjudgmental friendliness of a pet may provide stimulation, comfort, and contentment. Care of plants or a pet can also be satisfying and an outlet for energy.

AD does not eliminate the need for intimacy. Patients and their spouses may continue to enjoy sexual activity. Spouses should be encouraged to talk about any sexual concerns, and sexual counseling may be necessary. Simple expressions of love, such as touching and holding, are often meaningful.

Promoting Adequate Nutrition

Mealtime can be a pleasant social occasion or a time of upset and distress, and it should be kept simple and calm, without confrontations. Patients prefer familiar foods that look appetizing and taste good. Cueing may be necessary to encourage adequate nutrition and hydration. Food is cut into small pieces to prevent choking. Liquids may be easier to swallow if they are thickened. Hot food and beverages are served warm, and the temperature of the foods should be checked to prevent burns.

When lack of coordination interferes with self-feeding, adaptive equipment is helpful (see Fig. 53-5A). Some patients may do well eating with a spoon or with their fingers. If this is the case, an apron or a smock, rather than a bib, is used to protect clothing. As deficits progress, it may become necessary to feed the patient. Forgetfulness, disinterest, dental problems, lack of coordination, overstimulation, and choking all serve as barriers to good nutrition and hydration.

Promoting Balanced Activity and Rest

Many patients with dementia exhibit sleep disturbances, wandering, and behaviors that may be considered inappropriate. These behaviors are most likely to occur when there are unmet underlying physical or psychological needs. Caregivers must identify the needs of patients who are exhibiting these behaviors because further health decline may occur if the source of the problem is not corrected. Adequate sleep and physical exercise are essential. If sleep is interrupted or the patient cannot fall asleep, music, warm milk, or a back rub may help the patient relax. During the day, patients should be encouraged to participate in exercise because a regular pattern of activity and rest enhances nighttime sleep. Long periods of daytime sleeping are discouraged.

Home, Community and Transitional Care

The emotional burden on the families of patients with all types of dementia is enormous. The physical health of the patient is often very stable and the decline gradual. Family members may cling to the hope that the diagnosis is incorrect and that their relative will improve with greater effort. Family members provide at least 80% of the home care that is required by patients with AD (Gies et al., 2014). They are faced with numerous difficult decisions (e.g., when the patient should stop driving, when to assume responsibility for the patient's financial affairs). Aggression and hostility exhibited by the patient are often misunderstood by caregivers, who may feel unappreciated, frustrated, and angry. Feelings of guilt, nervousness, and worry contribute to caregiver fatigue, depression, and family dysfunction. Researchers have identified that a Web-based caregiver assessment can be an effective and efficient method of identifying care needs and planning interventions that promote balance and congruence in the lives of caregivers (Gies et al., 2014).

Neglect or abuse of the patient can occur, and this has been documented in home situations as well as in institutions. If neglect or abuse of any kind—including physical, emotional, sexual, neglect, or financial abuse—is suspected, the local adult





Figure 53-5 • A. Assistive feeding devices make it easy for patients to grasp and get food on utensils. **B.** Assistive feeding devices may be required for patients who are weak, fatigued, or paralyzed or have neuromuscular impairment.

protective services agency must be notified. The responsibility of the nurse is to report the suspected abuse, not to prove it.

The Alzheimer's Association is a coalition of family members and professionals who share the goals of family support and service, education, research, and advocacy. Family support groups, respite (relief) care, and adult day care may be available through different community resources, in which concerned volunteers are trained to provide structure to caregiver support groups. Respite care is a commonly provided service in which caregivers can get away from the home for short periods while someone else tends to the needs of the patient.

Parkinson Disease

PD is a slowly progressing neurologic movement disorder that eventually leads to disability. It affects about 1 million patients who are hospitalized in the United States each year (Moore, Smith, & Cho, 2017). The disease affects men more often than women. Symptoms usually first appear in the fifth decade of life; however, cases have been diagnosed as early as 30 years of age. The degenerative or idiopathic form of PD is the most common; there is also a secondary form with a known or suspected cause. Although the cause of most cases is unknown, research suggests a multifactorial combination of age, environment, and heredity (Moore et al., 2017).

It is more prevalent among Parsis who immigrated to India centuries ago from Persia than in Indians. (Muthane, Jain, & Gururaj, 2001). Highest incidence of PD has been reported in Mumbai city among Parsi community. It affects about 328 out of every 100,000 people despite living in a country, India, with one of the world's lowest incidence of PD (70 out of 100,000).

In Kolkata, average annual incidence rate was 5.71/100,000 per year and age-adjusted prevalence rate was 52.85/100,000 in 2010 and the adjusted average annual mortality rate was 2.89/100,000 per year (Das, Misra, Ray, et al., 2010).

Manganese-induced Parkinsonism is common in the manganese mine workers in India. These patients typically walk on their toes and fall frequently as they have severely impaired postural reflexes (Muthane, 2008).

Pathophysiology

PD is associated with decreased levels of dopamine resulting from degeneration of dopamine storage cells in the substantia nigra in the basal ganglia region of the brain (see Fig. 53-6). Fibers or neuronal pathways project from the substantia nigra to the corpus striatum, where neurotransmitters are vital to the control of complex body movements. Through the neurotransmitters acetylcholine (excitatory) and dopamine (inhibitory), striatal neurons relay messages to the higher motor centers that control and refine motor movements. The loss of dopamine stores in this area of the brain results in more excitatory neurotransmitters than inhibitory neurotransmitters, leading to an imbalance that affects voluntary movement (Hickey, 2014).

Clinical symptoms do not appear until 60% of the pigmented neurons are lost and the striatal dopamine level is decreased by 80%. Cellular degeneration impairs the extrapyramidal tracts that control semiautomatic functions and coordinated movements; motor cells of the motor cortex and the pyramidal tracts are not affected. Researchers are working on uncovering the exact mechanism of neurodegeneration. Current theories suggest a combined and complicated interweaving of both environmental and genetic factors that affect numerous fundamental cellular processes. Fifteen percent of early PD cases are associated with multiple genetic mutations (Gopalakrishna & Alexander, 2015). Ongoing research includes recognition of biomarkers and development of individualized treatment options (Kalia & Lang, 2015).

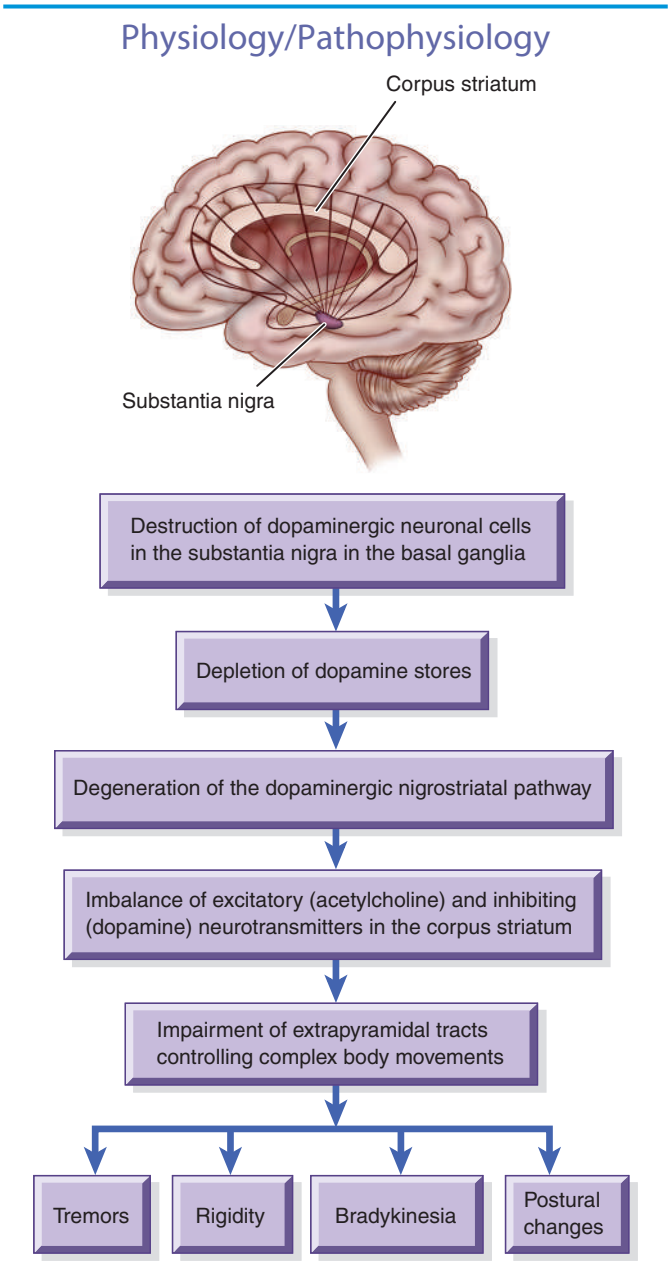


Figure 53-6 • Pathophysiology of Parkinson disease. The nuclei in the substantia nigra project fibers to the corpus striatum. The nerve fibers carry dopamine to the corpus striatum. The loss of dopamine nerve cells from the brain's substantia nigra is thought to be responsible for the symptoms of parkinsonism.

Clinical Manifestations

PD has a gradual onset, and symptoms progress slowly over a chronic, prolonged course. The cardinal signs are tremor, rigidity, bradykinesia/akinesia, and postural instability (Hickey, 2014). Two major subtypes of PD are evolving: tremor dominant (most other symptoms are absent) and nontremor dominant (akinetic-rigid and postural instability) (Kalia & Lang, 2015).

Tremor

Although symptoms are variable, a slow, unilateral resting tremor is present in the majority of patients at the time of diagnosis. Resting tremor characteristically disappears with purposeful movement and during sleep but is evident when the extremities are motionless or at rest. The tremor may manifest as a rhythmic, slow turning motion (pronation–supination) of the forearm and the hand and a motion of the thumb against the fingers as if rolling a pill between the fingers.

Rigidity

Resistance to passive limb movement characterizes muscle rigidity. Passive movement of an extremity may cause the limb to move in jerky increments, referred to as lead-pipe or cogwheel movements. Involuntary stiffness of the passive extremity increases when another extremity is engaged in voluntary active movement. Stiffness of the arms, legs, face, and posture are common. Early in the disease, the patient may complain of shoulder pain due to rigidity (Hickey, 2014).

Bradykinesia

One of the most common features of PD is bradykinesia, which refers to the overall slowing of active movement (Gopalakrishna & Alexander, 2015). Patients may also take longer to complete activities and have difficulty initiating movement, such as rising from a sitting position or turning in bed.

Postural Instability

The patient commonly develops postural and gait problems. Due to a loss of postural reflexes, the patient stands with the head bent forward and walks with a propulsive gait. The posture is caused by the forward flexion of the neck, hips, knees, and elbows. The patient may walk faster and faster, trying to move the feet forward under the body's center of gravity (shuffling gait). Difficulty in pivoting causes loss of balance, either forward (propulsion) or backward (retropulsion). Gait impairment and postural instability place the patient at increased risk for falls (Hickey, 2014). Approximately 80% of patients with a 17 years history of symptoms report gait impairment and falls (Kalia & Lang, 2015).

Other Manifestations

The effect of PD on the basal ganglia often produces autonomic symptoms that include excessive and uncontrolled sweating, drooling, paroxysmal flushing, orthostatic hypotension, gastric and urinary retention, constipation, and sexual dysfunction. Dysphagia remains a substantial problem as more than 50% of patients report choking as well as vision and olfactory changes (Hickey, 2014); (Kalia & Lang, 2015). Psychiatric changes include depression, anxiety, dementia (progressive mental deterioration), delirium, and hallucinations. Depression and anxiety are common; whether these are reactions to the disorder or related to a biochemical abnormality is uncertain (Moore et al., 2017). Stress, medications, and depression contribute to the cognitive changes of diminished executive functions, attention difficulties, decreased thinking, and word-finding challenges. More than 80% of patients with a 20-year disease duration of PD experience dementia (Kalia & Lang, 2015). In addition, auditory and visual hallucinations have been reported in up to 40% of people with PD and may be associated with depression, dementia, lack of sleep, or adverse effects of medications.

Hypokinesia (abnormally diminished movement) is also common and may appear after the tremor. The freezing phenomenon refers to a transient inability to perform active movement and is thought to be an extreme form of bradykinesia. The patient tends to shuffle and exhibits a decreased arm swing as well. As dexterity declines, micrographia (small handwriting) develops. The face becomes increasingly masklike and expressionless, and the frequency of blinking decreases. Dysphonia (voice impairment or altered voice production) may occur as a result of weakness and incoordination of the muscles responsible for speech. In many cases, the patient develops dysphagia, begins to drool, and is at risk for choking and aspiration (Hickey, 2014).

Complications associated with PD are common and are typically related to disorders of movement. As the disease progresses, patients are at risk for respiratory and urinary tract infection, skin breakdown, and injury from falls. The adverse effects of medications used to treat the symptoms are associated with numerous complications such as dyskinesia (impaired ability to execute voluntary movements) or orthostatic hypotension.

Assessment and Diagnostic Findings

Although laboratory tests and imaging studies are not helpful to the clinician in diagnosing PD ongoing research with PET and single-photon emission computed tomography scanning has been helpful in understanding the disease and advancing treatment. Currently, the disease is diagnosed clinically from the patient's history and the presence of two of the four cardinal manifestations: tremor, rigidity, bradykinesia, and postural changes.

Early diagnosis can be challenging because patients rarely are able to pinpoint when the symptoms started. Often, a family member notices a change such as stooped posture; a stiff arm; a slight limp; tremor; or slow, small handwriting. The medical history, presenting symptoms, neurologic examination, and response to pharmacologic management are carefully evaluated when making the diagnosis. Diagnosis is often confirmed by a positive response to a levodopa (Larodopa) trial (Hickey, 2014).

Medical Management

Treatment is directed toward controlling symptoms and maintaining functional independence, because no medical or surgical approaches in current use prevent disease progression. Care is individualized for each patient based on presenting symptoms and social, occupational, and emotional needs. Pharmacologic management is the mainstay of treatment, although advances in research have led to increased surgical options. Patients are usually cared for at home and are admitted to the hospital only for complications or to initiate new treatments.

Pharmacologic Therapy

Antiparkinsonian medications act by (1) increasing striatal dopaminergic activity; (2) reducing the excessive influence of excitatory cholinergic neurons on the extrapyramidal tract, thereby restoring a balance between dopaminergic and cholinergic activities; or (3) acting on neurotransmitter pathways other than the dopaminergic pathway. PD research efforts are focused on the development of disease-modifying drugs that slow or stop this neurodegenerative process (Kalia & Lang, 2015).

Levodopa is the most effective agent and the mainstay of treatment. Levodopa is converted to dopamine in the basal ganglia, producing symptom relief. Carbidopa is often added to levodopa to avoid metabolism of levodopa before it can reach the brain. The beneficial effects of levodopa therapy are

most pronounced in the first year or two of treatment. Benefits begin to wane and adverse effects become more severe over time (Hickey, 2014). Within 5 to 10 years, most patients develop a response to the medication characterized by dyskinesia including facial grimacing, rhythmic jerking movements of the hands, head bobbing, chewing and smacking movements, and involuntary movements of the trunk and extremities. The patient may experience an on–off syndrome in which sudden periods of near immobility ("off effect") are followed by a sudden return of effectiveness of the medication ("on effect"). Changing the drug dosing regimen or switching to other drugs may be helpful in minimizing the on–off syndrome. Other potential adverse effects include nausea, vomiting, appetite loss, decreased BP, dystonia, dyskinesia, and confusion (Moore et al., 2017). To minimize adverse effects of levodopa over time, current practice includes delaying use of levodopa-containing drugs as long as possible, with the use of other drugs for symptom control in the interim.

Nursing Alert: Nurses caring for patients with PD need a clear understanding of medications that are prescribed. Table 53-1 provides a summary of selected medications used in PD.

Surgical Management

The limitations of levodopa therapy, improvements in surgical techniques, and new approaches in transplantation have renewed interest in the surgical treatment of PD. In patients with disabling tremor, rigidity, or severe levodopa-induced dyskinesia, surgery may be considered. Although surgery provides symptom relief in selected patients, it has not been shown to alter the course of the disease or to produce permanent improvement.

Stereotactic Procedures

Thalamotomy and pallidotomy are ablative procedures that were formerly used to relieve symptoms of PD. However, these procedures permanently destroy brain tissue and are rarely used today. Deep brain stimulation (DBS) has largely replaced ablative procedures in the surgical treatment of PD (Kalia & Lang, 2015). DBS involves surgical implantation of an electrode into the brain in either the globus pallidus or subthalamic nucleus. Stimulation of these areas may increase dopamine release or block anticholinergic release, thereby improving tremor and rigidity. Levodopa medication dose may be able to be reduced, thus improving dyskinesias.

Patients eligible for DBS are those who have responded to levodopa but are impaired by dyskinesias, have had the disease for at least 5 years, and are disabled by tremor. Patients with dementia and atypical PD are usually not considered for surgical procedures. PD rating scales and specific neurologic tests are used to identify patients who are eligible. Surgical treatment typically occurs 10 to 13 years after diagnosis. Research is ongoing on the relationship between placing a DBS and patient quality of life (Kalia & Lang, 2015).

TABLE 53-1 Selected Medications Used to Treat Parkinson Disease

Medications	Indications and Therapeutic Effects	Common Side Effects
Anticholinergic Agents		
Trihexyphenidyl hydrochloride (Apo-Trihex)	Control of tremor in patients with early-onset disease	Blurred vision, flushing, rash, constipation, urinary retention, and acute confusional states
Benztropine mesylate (Cogentin)	Counteract the action of acetylcholine	Contraindicated in patients with narrow-angle glaucoma
Antiviral Agent		
Amantadine hydrochloride (Symmetrel)	Reduce rigidity, tremor, bradykinesia, and postural changes in early Parkinson disease (PD)	Psychiatric disturbances (mood changes, confusion, depression, hallucinations), lower extremity edema, nausea, epigastric distress, urinary retention, headache, and visual impairment
Dopamine Agonists		
Bromocriptine mesylate (Parlodel)	Early PD as well as secondary drug therapy after carbidopa or levodopa loses effectiveness	Nausea, vomiting, diarrhea, lightheadedness, hypotension, impotence, and psychiatric effects
Pergolide (Permax)		
Nonergot Derivatives		
Ropinirole hydrochloride (Requip)	Early stages of PD	May cause drowsiness or dizziness
Pramipexole (Mirapex)		
Monoamine Oxidase-Inhibitors		
Selegiline (Emsam)	Inhibit dopamine breakdown	Agitation, dizziness, nausea, headache, rhinitis, back pain, stomatitis, postural hypotension, insomnia
Rasagiline (Azilect)		
Catechol-O-Methyltransferase Inhibitors		
Entacapone (Comtan)	Increase the duration of action of carbidopa or levodopa	Abdominal pain, back pain, constipation, nausea, diarrhea, blood in urine
Tolcapone (Tasmar)	Reduce motor fluctuations in patients with advanced PD	

Adapted from Moore, D. J., Smith, B. M., & Cho, M. H. (2017). Managing meditations for hospital patients with Parkinson disease. American Nurse Today, 12(1), 9–12.



Figure 53-7 • A stereotactic frame is applied to a patient's head in preparation for deep brain stimulation. The frame provides external points of reference.

A CT or MRI scan is used to localize the appropriate surgical site in the brain. Then, the patient's head is positioned in a stereotactic frame (see Fig. 53-7). After the surgeon makes an incision in the skin and a burr hole, an electrode is passed through to the target area to the subthalamic nuclei or globus pallidus. The desired response of the patient to the electrical stimulation (i.e., a decrease in rigidity) is used to confirm electrode placement. Electrode placement is completed on one side of the brain at a time; bilateral electrodes are usually placed (AANN, 2014b). Electrodes are then connected to a pulse generator that is implanted in a subcutaneous subclavicular or abdominal pouch (see Fig. 53-8). The battery-powered pulse generator sends high-frequency electrical impulses through a wire placed under the skin to a lead anchored to the skull (see Fig. 53-8). These devices are not without complications that can result from both the surgical procedure needed for implantation (e.g., weakness, paresthesias, confusion, hemorrhage) and the device itself (e.g., infection, lead leakage) (Hickey, 2014).

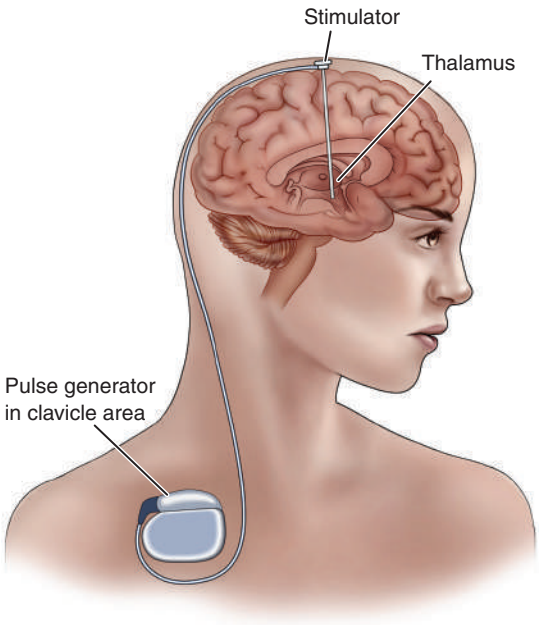


Figure 53-8 • Deep brain stimulation is provided by a pulse generator surgically implanted in a pouch beneath the clavicle. The generator sends high-frequency electrical impulses to the thalamus, thereby blocking the nerve pathways associated with tremors in Parkinson disease.

Neural Transplantation

Ongoing research is exploring transplantation of porcine neuronal cells, human fetal cells, and stem cells to replace degenerated striatal cells (Kim, Lee, & Kim, 2013). Legal, ethical, and political concerns surrounding the use of fetal brain cells and stem cells have limited the exploration of these procedures.

NURSING PROCESS

The Patient with Parkinson Disease

Assessment

Assessment focuses on how the disease has affected the patient's ADLs and functional abilities. The patient is observed for degree of disability and functional changes that occur throughout the day, such as responses to medication. Almost every patient with a movement disorder has some functional alteration and may have some type of behavioral dysfunction. The following questions may be useful to assess alterations:

- Do you have leg or arm stiffness?
- Have you experienced any irregular jerking of your arms or legs?
- Have you ever been "frozen" or rooted to the spot and unable to move?
- Does your mouth water excessively? Have you (or others) noticed yourself grimacing or making faces or chewing movements?
- What specific activities do you have difficulty doing?
- Have you had any recent falls?

During this assessment, the nurse observes the patient for quality of speech, loss of facial expression, swallowing deficits (drooling, poor head control, coughing), tremors, slowness of movement, weakness, forward posture, rigidity, evidence of mental slowness, and confusion. PD symptoms, as well as side effects of medications, put these patients at high risk for falls; therefore, a fall risk assessment should be conducted (Hickey, 2014); (Shin & Habermann, 2016a).

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Impaired physical mobility related to muscle rigidity and postural impairment
- Self-care deficits (feeding, dressing, bathing, and toileting) related to tremor and muscle rigidity
- Constipation related to medication and reduced activity
- Imbalanced nutrition: less than body requirements related to tremor, slowness in eating, difficulty in chewing and swallowing
- Impaired verbal communication related to decreased speech volume, slowness of speech, inability to move facial muscles
- Ineffective coping related to depression and dysfunction due to disease progression

Other nursing diagnoses may include sleep pattern disturbances, deficient knowledge, risk for injury, risk for activity intolerance, disturbed thought processes, and compromised family coping.

Planning and Goals

The goals for the patient may include improving functional mobility, maintaining independence in ADLs, achieving adequate bowel elimination, attaining and maintaining acceptable nutritional status, achieving effective communication, and developing positive coping mechanisms.

Nursing Interventions

Improving Mobility

A progressive program of daily exercise will increase muscle strength, improve coordination and dexterity, reduce muscular rigidity, and prevent contractures that occur when muscles are not used (Hickey, 2014). Walking, riding a stationary bicycle, swimming, and gardening are all exercises that help maintain joint mobility. Stretching (stretch–hold–relax) and range-of-motion exercises promote joint flexibility. Postural exercises are important to counter the tendency of the head and neck to be drawn forward and down. A physiotherapist may be helpful in developing an individualized exercise program and can provide instruction to the patient and caregiver on exercising safely. Faithful adherence to an exercise and walking program helps delay the progress of the disease. Warm baths and massage, in addition to passive and active exercises, help relax muscles and relieve painful muscle spasms that accompany rigidity.

Balance may be adversely affected because of the rigidity of the arms (arm swinging is necessary in normal walking). Special walking techniques must be learned to offset the shuffling gait and the tendency to lean forward. The patient is educated to concentrate on walking erect, to watch the horizon, and to use a wide-based gait (i.e., walking with the feet separated). A conscious effort must be made to swing the arms, raise the feet while walking, and use a heel–toe placement of the feet with long strides. The patient is advised to practice walking to marching music or to the sound of a ticking metronome, because this provides sensory reinforcement. Performing breathing exercises while walking provides additional movement of the ribcage and aerates larger parts of the lungs. Frequent rest periods aid in preventing frustration and fatigue.

Enhancing Self-Care Activities

Encouraging, educating, and supporting the patient during ADLs promote self-care (Hickey, 2014). See Chapters 38 and 51 for rehabilitation techniques.

Environmental modifications are necessary to compensate for functional disabilities. Patients may have severe mobility problems that make normal activities impossible. Adaptive or assistive devices may be useful. A hospital bed at home with bedside rails, an over-bed frame with a trapeze, or a rope tied to the foot of the bed can provide assistance in pulling up without help. An occupational therapist can evaluate the patient's needs in the home, make recommendations regarding adaptive devices, and educate the patient and caregiver how to improvise.

Improving Bowel Elimination

The patient may have severe problems with constipation. Among the factors causing constipation are weakness of the muscles used in defecation, lack of exercise, inadequate fluid intake, and decreased autonomic nervous system activity. The medications used for the treatment of the disease also inhibit normal intestinal secretions. A regular bowel routine may be established by encouraging the patient to follow a regular time pattern, consciously increase fluid intake, and eat foods with moderate fiber content. Laxatives should be avoided. Psyllium (Metamucil), for example, decreases constipation but carries the risk of bowel obstruction (Moore et al., 2017). A raised toilet seat is useful because the patient has difficulty in moving from a standing to a sitting position.

Improving Nutrition

Patients may have difficulty maintaining their weight. Eating becomes a very slow process, requiring concentration due to a dry mouth from medications and difficulty chewing and swallowing. These patients are at risk for aspiration because of impaired swallowing and the accumulation of saliva. They may be unaware that they are aspirating; subsequently, bronchopneumonia may develop.

Monitoring weight on a weekly basis indicates whether caloric intake is adequate. Supplemental feedings increase caloric intake. As the disease progresses, a nasogastric or percutaneous endoscopic gastrostomy (PEG) tube may be necessary to maintain adequate nutrition. A dietitian can be consulted regarding nutritional needs.

Enhancing Swallowing

Swallowing difficulties and choking are common in PD (Hickey, 2014). These can lead to problems with poor head control, tongue tremor, hesitancy in initiating swallowing, difficulty shaping food into a bolus, and disturbances in pharyngeal motility. To offset these problems, the patient should sit in an upright position during mealtime. A semisolid diet with thick liquids is easier to swallow than solids; thin liquids should be avoided. Thinking through the swallowing sequence is helpful. The patient is instructed to place the food on the tongue, close the lips and teeth, lift the tongue up and then back, and swallow. The patient is encouraged to chew first on one side of the mouth and then on the other. To control the buildup of saliva, the patient is reminded to hold the head upright and make a conscious effort to swallow. Massaging the facial and neck muscles before meals may be beneficial.

Encouraging the Use of Assistive Devices

An electric warming tray keeps food hot and allows the patient to rest during the prolonged time that it may take to eat. Special utensils also assist at mealtime. A plate that is stabilized, a nonspill cup, and eating utensils with built-up handles are useful self-help devices. The occupational therapist can assist in identifying appropriate adaptive devices. Individualized, innovative rehabilitative therapies can increase function in the patient with PD (Abbruzzese, Marchese, Avanzino, et al., 2016).

Improving Communication

Speech disorders are present in most patients with PD. The low-pitched, monotonous, soft speech of patients requires that they make a conscious effort to speak slowly, with deliberate attention to what they are saying. The patient is reminded to face the listener, exaggerate the pronunciation of words, speak in short sentences, and take a few deep breaths before speaking. A speech therapist may be helpful in designing speech improvement exercises and assisting the family and health care personnel to develop and use a method of communication that meets the patient's needs. A small electronic amplifier is helpful if the patient has difficulty being heard.

Supporting Coping Abilities

Support can be given by encouraging the patient and pointing out that activities will be maintained through active participation. A combination of physiotherapy, psychotherapy, medication therapy, and support group participation may help

reduce the depression that often occurs (Hickey, 2014). Patients with PD can become socially and emotionally withdrawn. It is best if patients are active participants in their therapeutic program, including social and recreational events. A planned program of activity throughout the day prevents too much daytime sleeping as well as disinterest and apathy.

Patients often feel embarrassed, apathetic, inadequate, bored, and lonely. In part, these feelings may result from physical slowness and the great effort that even small tasks require. The patient is assisted and encouraged to set achievable goals (e.g., improvement of mobility). Every effort should be made to encourage patients to carry out the tasks involved in meeting their own daily needs and to remain independent. Doing things for the patient merely to save time undermines the basic goal of improving coping abilities and promoting a positive self-concept.

Promoting Home, Community-Based, or Transitional Care

Educating Patients about Self-Care. Patient and family education is important in the management of PD. The needs depend on the severity of symptoms and the stage of the disease. Care must be taken not to overwhelm the patient and family with too much information early in the disease process. Ongoing assessment, intervention, and evaluation of the patient and family's adaptations and education requirements are necessary with every encounter. The strategies to promote health include a clear explanation of the disease and the goal of assisting the patient to remain functionally independent as long as possible (see Chart 53-3). The patient and family must be educated about the effects and side effects of medications and about the importance of reporting side effects to the primary provider. Nurses in the home help patients and their families enhance self-management and quality of life (Shin & Habermann, 2016 b).

Continuing and Transitional Care. Family members and partners often serve as caregivers, with home, community-based or transitional services available to assist in meeting health care needs as the disease progresses. The caregiver may be under considerable stress from living with and caring for a person with a significant disability. Providing information about treatment and care helps anticipate future needs. The caregiver is included in the plan and may be advised to learn stress reduction techniques, to include others in the caregiving process, to obtain periodic relief from responsibilities, and to have a yearly health assessment. Allowing family members and partners to express feelings of frustration, anger, and guilt is often helpful to them (Martin, 2015) (see Chart 53-4).

The patient should be evaluated in the home for adaptation and safety needs and compliance with the plan of care. In the advanced stages, patients usually enter long-term care facilities. Periodically, admission to an acute care facility may be necessary for changes in medical management or treatment of complications. Nurses provide support, education, and monitoring of patients over the course of the illness (Shin & Habermann, 2016b).

The nurse involved in home and continuing care educates the patient and family members about the importance of addressing health promotion needs such as screening for hypertension and stroke risk assessments in this predominantly older adult population. Patients are referred to appropriate health care providers. Information is available from both the Parkinson Disease Foundation and the American Parkinson's Disease Association (see the Resources section).

Evaluation

Expected patient outcomes may include:

1. Strives toward improved mobility
   a. Participates in exercise program daily
   b. Walks with wide base of support; exaggerates arm swinging when walking
   c. Takes medications as prescribed
2. Progresses toward self-care
   a. Allows time for self-care activities
   b. Uses self-help devices
3. Maintains bowel function
   a. Consumes adequate fluid
   b. Increases dietary intake of fiber
   c. Reports regular pattern of bowel function
4. Attains improved nutritional status
   a. Swallows without aspiration
   b. Takes time while eating
5. Achieves a method of communication

Chart 53-3 HEALTH PROMOTION

Strategies for the Patient with PD

To promote optimal health, the nurse works closely with the patient and family to ensure that they understand:

- How PD and its treatment impact physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality
- The importance of adhering to the prescribed medication regimen; including knowing the purpose, dose, route, schedule, side effects, and precautions for all medications
- How and when to contact all members of the treatment team (e.g., health care providers, home care professionals, and durable medical equipment and supply vendors)
- Specific types of environmental and safety changes or support that will allow optimum functioning in the home
- The risk of falls/injury and how to implement fall prevention and adaptive measures in the home

In addition, the nurse advises the patient and family about lifestyle changes that are necessary to maintain health and promote self-care and independence. These include:

- Ensuring nutritional needs, including adhering to dietary restrictions, managing dysphagia, and preventing aspiration
- Promoting speech and communication skills: speech exercises, communication techniques, breathing exercises
- Managing constipation: fluid intake, bowel routine
- Managing urinary problems: functional incontinence, retention (indwelling urinary catheter care, suprapubic catheter care)
- Avoiding the effects of immobility and promoting the advantages of preventive care: skin breakdown (frequent turning, pressure release, skin care), pneumonia (deep breathing, movement), contractures (range-of-motion exercises)
- Promoting the benefits of a daily exercise program
- Ensuring safe walking and balancing
- Using appropriate coping mechanisms and diversional activities

PD, Parkinson disease; ADL, activities of daily living; IADL, independent activities of daily living.

Chart 53-4 NURSING RESEARCH PROFILE

When a Partner Has Parkinson Disease

Martin, S. C. (2015). Psychosocial challenges experienced by partners of people with Parkinson disease. Journal of Neuroscience Nursing, 47(4), 211–222.

Purpose

Persons with PD may experience devastating effects that impact those individuals who are close to them as well as the person experiencing the disease. The purpose of this study was to investigate the psychosocial experience of partners of people with PD.

Design

This qualitative descriptive study used in-depth interviews to investigate the psychosocial experience of partners of people with PD. A semistructured interview guide was used with 23 participants (15 women, 8 men) who identified that they were in a committed, romantic relationship with a person with PD.

Findings

Data analysis revealed a multitude of challenges for partners of people with PD. Some challenges included having the person with PD withdraw from communication, being unable to "rescue" the person from their disease (PD), and being the recipient of the person with PD's frustration. Additional challenges included becoming impatient with the person with PD, shouldering increased responsibilities, being confronted with the prospect of losing the person with PD, losing valued activities, being unable to predict the person with PD's daily well-being, and experiencing uncertainty about future caregiving and disease progression.

Nursing Implications

Partners of persons with PD face significant psychosocial challenges related to both caregiving and noncaregiving issues. Nurses should be prepared to provide reassurance to partners of persons with PD that their feelings are normal, as well as offer direction on how to enlist the support of family and friends and access additional support services.

   a. Communicates needs
   b. Practices speech exercises
6. Copes with effects of PD
   a. Sets realistic goals
   b. Demonstrates persistence in meaningful activities
   c. Verbalizes feelings to appropriate person

Huntington Disease

Huntington disease is a chronic, progressive, hereditary disease of the nervous system that results in progressive involuntary choreiform movement and dementia. The disease affects approximately 1 in 10,000 men or women of all races at midlife. Every person has the gene that causes Huntington disease; however, only those who inherit the expansion of the gene will develop the disease and pass it onto their children. Because it is transmitted by an autosomal dominant gene, each child of a parent with Huntington disease has a 50% risk of inheriting the disorder (Bader et al., 2016).

The prevalence of Huntington disease in Asia is much lower (0.40 per 100,000 population) than European countries (5.70 per 100,000 population) (Xu & Wu, 2015). Among the emerging countries, India appears after the 15th position in reference to incidence of HD (Barboza & Ghisi, 2018).

A genetic mutation in Huntington disease, the presence of a repeat in the Huntington gene (*HTT*), has been identified. Genetic testing can identify people who will develop this disease but cannot predict timing of disease onset. Although the gene was mapped in 1983, patients may choose not to be tested because of concerns about employment and health care discrimination. People of childbearing age with a family history of Huntington disease often seek information about their risk of disease transmission. Genetic counseling is crucial, and patients and their families may require long-term psychological counseling and emotional, financial, and legal support.

Pathophysiology

The basic pathology involves premature death of cells in the striatum (caudate and putamen) of the basal ganglia, the region deep within the brain that is involved in the control of movement. Cells also are lost in the cortex, the region of the brain associated with thinking, memory, perception, judgment, and behavior, and in the cerebellum, the area that coordinates voluntary muscle activity. Why the protein destroys only certain brain cells is unknown, but several theories have been proposed to explain the phenomenon. One possible theory is that glutamine, a building block for protein, abnormally collects in the cell nucleus, causing cell death (Ferrer, 2016). A brief pathophysiological mechanism of Huntington disease is presented in Figure 53-9.

Clinical Manifestations

This condition is characterized by a triad of symptoms: (1) motor dysfunction (the most prominent is chorea, or rapid, jerky, involuntary, purposeless movements); (2) cognitive impairment (problems with attention and emotion recognition); and (3) behavioral features, such as apathy and blunted affect (Bader et al., 2016). As the disease progresses, constant writhing, twisting, and uncontrollable movements may involve the entire body. These motions are devoid of purpose or rhythm, although patients may try to turn them into purposeful movement. All of the body musculature is involved. Facial movements produce tics and grimaces. Speech becomes slurred, hesitant, often explosive, and eventually unintelligible. Chewing and swallowing are difficult, and there is a constant danger of choking and aspiration. Choreiform movements persist during sleep but are diminished (Wilson, Pollock, & Aubeeluck, 2014).

As with speech, the gait becomes disorganized to the point that ambulation eventually is impossible. Although independent ambulation should be encouraged for as long as possible, a wheelchair usually becomes necessary. Eventually, the patient is confined to bed when the chorea interferes with walking, sitting, and all other activities. Bladder and bowel control is lost.

Cognitive impairment, such as problems with attention or emotion recognition, occurs early on while in later stages, marked dementia is present. Initially, the patient is aware that the disease is responsible for the myriad dysfunctions that are occurring.

The behavioral changes may be more devastating to the patient and family than the abnormal movements. Personality changes may result in nervous, irritable, or impatient behaviors. In the early stages, patients are particularly subject to uncontrollable fits of anger, profound and often suicidal depression, apathy, anxiety, psychosis, or euphoria. Judgment and memory are

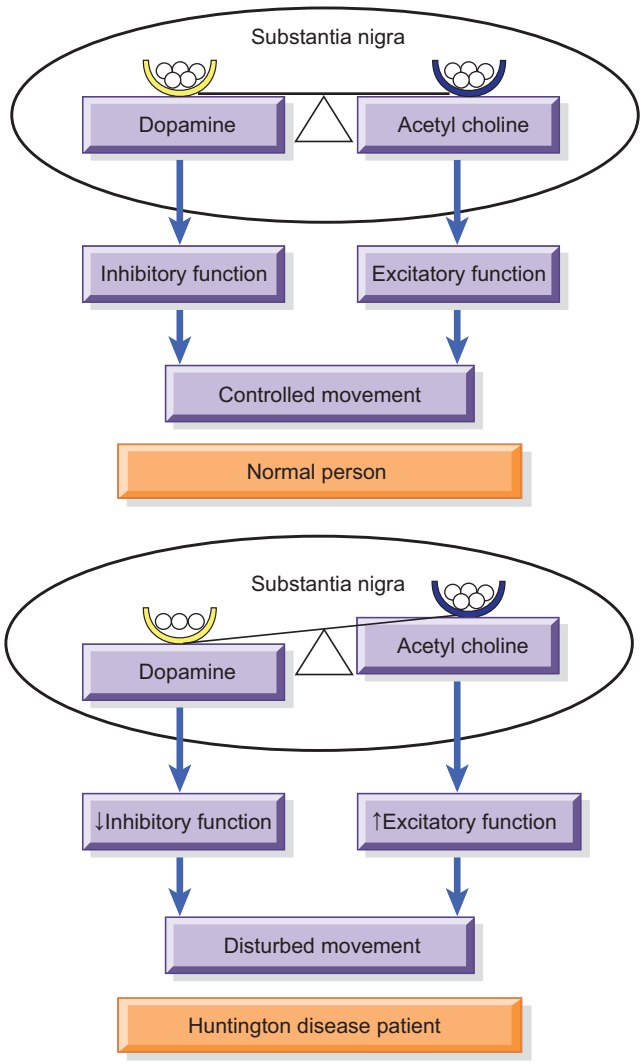


Figure 53-9 • Pathophysiological mechanism of Huntington disease.

impaired, and dementia eventually ensues (Ross, Aylward, Wild, et al., 2014). Hallucinations, delusions, and paranoid thinking may precede the appearance of disjointed movements. Emotional and cognitive symptoms often become less acute as the disease progresses (Wilson et al., 2014).

Onset usually occurs between 35 and 45 years of age, although about 10% of patients are children. The disease progresses slowly. Despite a ravenous appetite, patients usually become emaciated and exhausted. Patients succumb in 10 to 20 years to heart failure, pneumonia, or infection, or as a result of a fall or choking.

Assessment and Diagnostic Findings

The diagnosis is made based on the clinical presentation of characteristic symptoms, a positive family history, and the known presence of the genetic marker CAG repeats in *HTT* (Bader et al., 2016). CT or MRI scans show symmetrical striatal atrophy before motor symptoms appear (Ross et al., 2014).

Medical Management

No treatment halts or reverses the underlying process; therefore, the focus is on optimizing quality of life with available medication and supportive treatment. Patients experience the most benefit when they have integrated expertise of a Huntington disease multidisciplinary team (Smith, D'Cruz, Gray, et al., 2015). The only medication that is approved by the Food and Drug Administration to treat the symptom of chorea is tetrabenazine (Xenazine) (Kumar, Singh, Kumar, et al., 2015).

Benzodiazepines and neuroleptic drugs have also been reported to control chorea. Motor signs must be assessed and evaluated on an ongoing basis so that optimal therapeutic drug levels can be reached. Akathisia (motor restlessness) in the patient who is overmedicated is dangerous because it may be mistaken for the restless fidgeting of the illness and consequently may be overlooked. In certain types of the disease, hypokinetic motor impairment resembles PD. In patients who present with rigidity, some temporary benefit may be obtained from antiparkinson medications, such as levodopa.

Selective serotonin reuptake inhibitors and tricyclic antidepressants have been recommended for control of psychiatric symptoms. The threat of suicide is present particularly early in the course of the disease. Psychotic symptoms usually respond to antipsychotic medications. Psychotherapy aimed at allaying anxiety and reducing stress may be beneficial. Nurses must look beyond the disease to focus on the patient's needs and capabilities (see Chart 53-5).

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

The needs of the patient and family for education depend on the nature and severity of the physical, cognitive, and psychological changes experienced by the patient. The patient and family members are educated about the medications prescribed and about signs indicating a need for change in medication or dosage. The educational plan addresses strategies to manage symptoms such as chorea, swallowing problems, limitations in ambulation, memory loss, irritability, depression, and loss of bowel and bladder function. Consultation with a speech therapist may be indicated to assist in identifying alternative communication strategies if speech is affected. A PEG tube may be considered for nutritional support later in the disease (Wilson et al., 2014).

Continuing and Transitional Care

A program combining medical, nursing, psychological, social, occupational, speech, and physical rehabilitation services and palliative care is needed to help the patient and family cope with this severely disabling illness. Huntington disease exacts enormous emotional, physical, social, and financial tolls on every member of the family. The family needs supportive care as they adjust to the impact of the illness. Regular follow-up visits help allay the fear of abandonment.

Home care assistance, day care centers, respite care, and eventually skilled long-term care can assist the patient and family in coping with the constant strain of the illness. Although the relentless progression of the disease cannot be halted, families can benefit from supportive care. Planning for end-of-life care should occur early in the disease when possible (see Chapter 59).

Voluntary organizations can be major aids to families and have been largely responsible for bringing the illness to national attention.

Amyotrophic Lateral Sclerosis

ALS is a disease of unknown cause in which there is a loss of motor neurons (nerve cells controlling muscles) in the anterior

Chart 53-5

Care of the Patient with Huntington Disease

Nursing Diagnosis: Risk for injury from falls and possible skin breakdown (pressure ulcers, abrasions), resulting from constant movement

Nursing Interventions

Pad the sides and head of the bed; ensure that the patient can see over the sides of bed.
Use padded heel and elbow protectors.
Keep the skin meticulously clean.
Apply emollient cleansing agent and skin lotion as needed.
Use soft sheets and bedding.
Have patient wear football padding or other forms of padding.
Encourage ambulation with assistance to maintain muscle tone.
Secure the patient (only if necessary) in bed or chair with padded protective devices, making sure that they are loosened frequently.

Nursing Diagnosis: Imbalanced nutrition: less than body requirements due to inadequate intake and dehydration resulting from swallowing or chewing disorders and danger of choking or aspirating food

Nursing Interventions

Administer phenothiazines (chlorpromazine) as prescribed before meals (calms some patients).
Talk to the patient before mealtime to promote relaxation; use mealtime for social interaction. Provide undivided attention and help the patient enjoy the mealtime experience.
Use a warming tray to keep food warm.
Learn the position that is best for *this* patient. Keep patient as close to upright as possible while feeding. Stabilize patient's head gently with one hand while feeding.
Show the food, explain what the foods are, and temperature (e.g., whether hot or cold).
Encircle the patient with one arm and get as close as possible to provide stability and support while feeding. Use pillows and wedges for additional support.
Do not interpret stiffness, turning away, or sudden turning of the head as rejection; these are uncontrollable choreiform movements.
For feeding, use a long-handled spoon (iced tea spoon). Place spoon on middle of tongue and exert slight pressure.
Place bite-sized food between patient's teeth. Serve stews, casseroles, and thick liquids.
Disregard messiness, and treat the person with dignity.
Wait for the patient to chew and swallow before introducing another spoonful. Make sure that bite-sized food is small.
Give between-meal feedings. Constant movement expends more calories. Patients often have voracious appetites, particularly for sweets.
Use blenderized meals if patient cannot chew; do not repeatedly give the same strained baby foods. Gradually introduce increased textures and consistencies to the diet.
For swallowing difficulties:
- Apply gentle deep pressure around the patient's mouth.
- Rub fingers in circles on the patient's cheeks and then down each side of the patient's throat.
- Develop skill in the abdominal thrust (to be used in the event of choking).

Nursing Diagnosis: Impaired communication from excessive grimacing and unintelligible speech

Nursing Interventions

Read to the patient.
Employ biofeedback and relaxation therapy to reduce stress.
Consult with speech therapist to help maintain and prolong communication abilities.
Try to devise a communication system, perhaps using cards with words or pictures of familiar objects, before verbal communication becomes too difficult. Patients can indicate correct card by hitting it with hand, grunting, or blinking the eyes.
Learn how this particular patient expresses needs and wants—particularly nonverbal messages (widening of eyes, responses).
Patients can understand even if unable to speak. Do not isolate patients by ceasing to communicate with them.

Nursing Diagnosis: Confusion and impaired social interaction

Nursing Interventions

Reorient the patient after awakening.
Have clock, calendar, and wall posters in view to assist in orientation.
Use every opportunity for one-to-one contact.
Use music for relaxation.
Have the patient wear a medical identification bracelet.
Keep the patient in the social mainstream.
Recruit and train volunteers for social interaction. Role-model appropriate and creative interactions.
Do not abandon a patient because the disease is terminal. Patients are *living* until the end.

horns of the spinal cord and the motor nuclei of the lower brainstem. It is often referred to as Lou Gehrig disease, after the famous baseball player who suffered from the disease. As motor neuron cells die, the muscle fibers that they supply undergo atrophic changes. Neuronal degeneration may occur in both the upper and lower motor neuron systems (see Chapter 48). The leading theory held by researchers is that overexcitation of nerve cells by the neurotransmitter glutamate results in cell injury and neuronal degeneration. Risk factors that have been identified include smoking, viral infections, autoimmune disease, and environmental exposures to toxins. For example, veterans who deployed during the 1991 Gulf War had an increased number of cases of ALS compared to those who did not serve in that region. However, the exact cause is still unknown and requires further exploration (Bellomo & Cichminski, 2015).

ALS most commonly occurs between 40 and 60 years of age and affects all social, racial, and ethnic backgrounds, with men being affected at slightly higher rates than women. The majority of cases of ALS arise sporadically, but 5% to 10% of cases are familial ALS resulting from an autosomal dominant trait carried by one parent. Familial ALS occurs 10 years earlier than the ALS average, and those afflicted tend to have a shorter life span (Bellomo & Cichminski, 2015). About 30% of patients with ALS live for 5 years after diagnosis, with 10% to 20% surviving for up to 10 years and 5% surviving greater than 20 years postdiagnosis.

The prevalence of ALS in India is 6 per 100,000 persons and higher among people above 50 years of age. It is more common in male than female (2:1) (Praveen, 2015). Risk factors such as cigarette smoking, ingestion of non-protein amino acids, intense physical activity, and viral infections play a role in causation of ALS (Bastos, Orsini, Machado, et al., 2011) (Cone et al, Nazemi, & Cone, 2002) (Ferraiuolo, De Bono, Heath, et al., 2009).

Clinical Manifestations

Clinical manifestations depend on the location of the affected motor neurons, because specific neurons activate specific muscle fibers. The chief symptoms are fatigue, progressive muscle weakness, cramps, fasciculations (twitching), and lack of coordination. Loss of motor neurons in the anterior horns of the spinal cord results in progressive weakness and atrophy of the muscles of the arms, trunk, or legs. Spasticity usually is present, and the deep tendon stretch reflexes become brisk and overactive. Usually, the function of the anal and bladder sphincters remains intact, because the spinal nerves that control muscles of the rectum and urinary bladder are not affected.

In about 25% of patients, weakness starts in the muscles supplied by the cranial nerves, and difficulty in talking, swallowing, and ultimately breathing occurs. When the patient ingests liquids, soft palate and upper esophageal weakness cause the liquid to be regurgitated through the nose. Weakness of the posterior tongue and palate impairs the ability to laugh, cough, or even blow the nose. If bulbar muscles are impaired, speaking and swallowing are progressively difficult, and aspiration becomes a risk. The voice assumes a nasal sound, and articulation becomes so disrupted that speech is unintelligible. Some emotional lability may be present. It was traditionally believed that ALS spared cognitive function, but it is now recognized that some patients experience cognitive impairment.

The prognosis generally is based on the area of CNS involvement and the speed with which the disease progresses. Eventually, respiratory function is compromised. Death usually occurs as a result of infection, respiratory insufficiency, or aspiration.

Assessment and Diagnostic Findings

ALS is diagnosed on the basis of the signs and symptoms, because no clinical or laboratory tests are specific to this disease. Electromyography and muscle biopsy studies of the affected muscles indicate reduction in the number of functioning motor units. An MRI scan may show high signal intensity in the corticospinal tracts; this differentiates ALS from a multifocal motor neuropathy. Neuropsychological testing can assist in assessment and diagnosis (Hickey, 2014).

Management

No cure exists for ALS. The main focus of medical and nursing management is on interventions to maintain or improve function, well-being, and quality of life. Because ALS is a progressive disease, the therapeutic needs are different than those of patients with acute processes (Majmuder, Wu, & Pagnoni, 2014).

Riluzole (Rilutek), a glutamate antagonist, has been shown to prolong survival for persons with ALS for 3 to 6 months (Hickey, 2014). The action of riluzole is not clear, but its pharmacologic properties suggest that it may have a neuroprotective effect in the early stages of ALS. Symptomatic treatment and rehabilitative measures are used to support the patient and improve the quality of life. Baclofen (Lioresal), dantrolene sodium (Dantrium), or diazepam (Valium) may be useful for patients troubled by spasticity, which causes pain and interferes with self-care. Modafinil (Provigil) may be used for fatigue, and additional medications may be added to manage the pain, depression, drooling, and constipation that often accompany the disease. Research suggests that greater functional impairment is associated with greater depressive symptoms; consequently, managing depression helps to maintain a better quality of life (Rosengren, Gustafusson, & Jarnevi, 2015). Ongoing research for treatment options include neural transplantation (Carletti, Rispoli, DiChirico, et al., 2016).

Most patients with ALS are managed at home and in the community, with hospitalization for acute problems. The most common reasons for hospitalization are dehydration and malnutrition, pneumonia, and respiratory failure; recognizing these problems at an early stage in the illness allows for the development of preventive strategies. End-of-life issues include pain, dyspnea, and delirium (Hickey, 2014).

Mechanical ventilation (using negative-pressure ventilators) is an option if alveolar hypoventilation develops. Noninvasive positive-pressure ventilation is also an option. The use of noninvasive positive-pressure ventilation is particularly helpful at night and postpones the decision about whether to undergo a tracheotomy for long-term mechanical ventilation (Rabinstein, 2016). A patient experiencing aspiration and swallowing difficulties may require enteral feeding. A PEG tube is inserted before the forced vital capacity drops below 50% of the predicted value. The tube can be safely placed in patients who are using noninvasive positive-pressure ventilation for ventilatory support (Hickey, 2014); (ProGas Study Group, 2015).

Decisions about life support measures are made by the patient and family and should be based on a thorough understanding of the disease, the prognosis, and the implications of initiating such therapy. Patients are encouraged to complete an advance directive ("living will") to preserve their autonomy in decision making. See Chapter 59 for additional discussion of end-of-life care.

The ALS Association has broad programs of research funding, patient and clinical services, patient information and support, and medical and public information (see the Resources section). The *ALS Association Newsletter* is a source of practical information.

Muscular Dystrophies

The muscular dystrophies are a group of incurable muscle disorders characterized by progressive weakening and wasting of the skeletal or voluntary muscles with 30 different types to date. Most of these diseases are inherited. Duchenne muscular dystrophy, the most common and severe type, occurs in 1 of every 3500 male births (Bader et al., 2016).

The prevalence of muscular dystrophies in India is about 29 per 100,000 population (Duraiswamy, 2009).

The pathologic features include degeneration and loss of muscle fibers, variation in muscle fiber size, phagocytosis and regeneration, and replacement of muscle tissue by connective tissue. The common characteristics of these diseases include varying degrees of muscle wasting and weakness and abnormal elevation in serum levels of muscle enzymes. Differences among these diseases center on the genetic pattern of inheritance, the muscles involved, the age at onset, and the rate of disease progression. The symptoms can be diverse and may include muscle stiffness or weakness, dysphagia, mental deficits, vision, or infertility. Prognosis depends on the type of muscular dystrophy. Regardless of age of onset, this disease varies in progression (Dalton & Sampson, 2015). The unique needs of these patients, who in the past did not live to adulthood, must be addressed, considering they live longer because of better supportive care.

Medical Management

Treatment of the muscular dystrophies focuses on supportive care and prevention of complications in the absence of a cure or specific

pharmacologic interventions (Kang, Morrison, Iannaccone, et al., 2015). The goal of supportive management is to keep the patient active and functioning as normally as possible and to minimize functional deterioration. An individualized therapeutic exercise program is prescribed to prevent muscle tightness, contractures, and disuse atrophy. Night splints and stretching exercises are used to delay contractures of the joints, especially the ankles, knees, and hips. Braces may compensate for muscle weakness.

Spinal deformity is a severe problem. Weakness of trunk muscles and spinal collapse occur almost routinely in patients with severe neuromuscular disease. To help prevent spinal deformity, the patient is fitted with an orthotic jacket to improve sitting stability and reduce trunk deformity. This measure also supports cardiovascular status. In time, spinal fusion is performed to maintain spinal stability. Other procedures may be carried out to correct deformities.

Compromised pulmonary function may result either from progression of the disease or from deformity of the thorax secondary to severe scoliosis. Upper respiratory infections and fractures from falls must be vigorously treated in a way that minimizes immobilization because joint contractures become worse when the patient's activities are more restricted than usual.

Other difficulties may manifest in relation to the underlying disease. Weakness of the facial muscles makes it difficult to attend to dental hygiene and to speak clearly, and impairs the ability to swallow safely (LaDonna, Koopman, Ray, et al., 2016). Gastrointestinal tract problems may include gastric dilation, rectal prolapse, and fecal impaction. Finally, cardiomyopathy appears to be a common complication in all forms of muscular dystrophy.

Ongoing research is improving the clinical course and survival opportunities. Some research targets specific gene mutations, while other studies deal with the effects of muscle degeneration (Mercuri & Muntoni, 2013). Genetic counseling is advised for parents and siblings of the patient because of the genetic nature of this disease.

Nursing Management

The goals of the patient and the nurse are to maintain function at optimal levels and to enhance the quality of life. Therefore, the patient's physical requirements, which are considerable, are addressed without losing sight of emotional and developmental needs. The patient and family are actively involved in decision making, including end-of-life decisions (see Chapter 59).

During hospitalization for treatment of complications, the knowledge and expertise of the patient and family members responsible for caregiving in the home are assessed. Because the patient and family caregivers often have developed caregiving strategies that work effectively for them, these strategies need to be acknowledged and accepted, and provisions must be made to ensure that they are maintained during hospitalization (Piredda, Matarese, & Mastroianni, 2015).

Families of adolescents and young adults with muscular dystrophy need assistance to shift the focus of care from pediatric to adult care and to understand the usual disease course. Nursing goals include assisting the adolescent to make the transition to adult values and expectations while providing age-appropriate ongoing care. The nurse may need to help build the confidence of an older adolescent or adult patient by encouraging him or her to pursue job training to become economically independent. Other nursing interventions might include guidance in accessing adult health care and finding appropriate programs in sex education.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

Management goals are addressed in special rehabilitation programs or in the patient's home and community. Therefore, the patient and family require information and instruction about the disorder, its anticipated course, and care and management strategies that will optimize the patient's growth and development and physical and psychological status. Members of a variety of health-related disciplines are involved in patient and family education; recommendations are communicated to all members of the health care team so that they may work toward common goals.

Continuing and Transitional Care

Both the neuromuscular disease and the associated deformities may progress in adolescence and adulthood. Self-help and assistive devices can aid in maintaining maximum independence. These devices, recommended by physical and occupational therapists, often become necessary as more muscle groups are affected.

The family is instructed to monitor the patient for respiratory problems, because respiratory infection and cardiac failure are the most common causes of death. As respiratory difficulties develop, patients and their families need information regarding respiratory support. Options currently exist that can provide ventilatory support (e.g., negative-pressure devices, positive-pressure ventilators) while allowing mobility (Dalton & Sampson, 2015); (Rabinstein, 2016). Patients can remain relatively independent in a wheelchair, for example, while being maintained on a ventilator at home for many years.

The patient is encouraged to continue with range-of-motion exercises to prevent contractures, which are particularly disabling. Practical adaptations must be made, however, to cope with the effects of chronic neuromuscular disability. The patient at various stages of the disease may require a manual or an electric wheelchair, gait aids, upper and lower extremity and spinal orthotics, seating systems, bathroom equipment, lifts, ramps, and additional assistive devices, all of which require a team approach. The nurse assesses how the patient and family are managing, makes referrals, and coordinates the activities of the physical therapist, occupational therapist, and social services.

The patient is greatly concerned about issues surrounding the threat of increasing disability and dependence on others, accompanied by a significant deterioration in health-related quality of life. The patient is faced with a progressive loss of function, leading eventually to death. Feelings of helplessness and powerlessness are common. Each functional loss is accompanied by grief and mourning. The patient and family are assessed for depression, anger, or denial. The patient and family are assisted and encouraged to address decisions about end-of-life options before their need arises (see Chapter 59).

A psychiatric nurse clinician or other mental health professional may assist the patient to cope and adapt to the disease. By understanding and addressing clinical concerns that are important for patients and their families, while at the same time assessing caregiver knowledge and burden during every encounter, the nurse provides a hopeful, supportive, and nurturing environment (LaDonna et al., 2016). One study reported that adult patients' illness perceptions are directly connected to their quality of life in muscular dystrophy, and these perceptions influence their overall mood (Graham, Weinman, Sadjadi, et al., 2014).

Degenerative Disc Disease

Low back pain is the second most common neurologic disorder in the United States, with one quarter of all adults reporting recent (within 3 months) back pain (Hickey, 2014). It is frequently associated with depression and anxiety, and it is the most common reason for missed work and decreased productivity while at work. An estimated 500,000 spinal surgeries for herniated discs, stenosis, and degenerative changes were performed in 2010 in the United States. Low back pain results in significant economic costs to patients, their families, and society. Acute pain lasts less than 3 months (see Chart 37-2 in Chapter 37), whereas chronic pain has a duration of 3 months or longer. Most back problems are related to disc disease (Bader et al., 2016).

Different individual studies reported a wide variation in the prevalence of low back pain among Indians; prevalence in selected population was as high as 50% in National Capital Region (Bihari, Kesavachandran, Pangtey, et al., 2011), to 34.2% in Pune (Banerjee, Jadhav, & Bhawalkar, et al., 2012), 17.3% in Western India (Chopra, Patil, Billempelly, et al., 2001), and 6.2% in Jodhpur (Haldiya, Mathur, Mathur, et al., 2009).

Pathophysiology

The intervertebral disc is a cartilaginous plate that forms a cushion between the vertebral bodies (see Fig. 53-10A). This tough, fibrous material is incorporated in a capsule. A ball-like cushion in the center of the disc is called the *nucleus pulposus.* In herniation of the intervertebral disc (ruptured disc), the nucleus of the disc protrudes into the annulus (the fibrous ring around the disc), with subsequent nerve compression (Hickey, 2014). Protrusion or rupture of the nucleus pulposus usually is preceded by degenerative changes that occur with aging. Loss of protein polysaccharides in the disc decreases the water content of the nucleus pulposus. The development of radiating cracks in the annulus weakens resistance to nucleus herniation. After trauma (falls and repeated minor stresses such as lifting incorrectly), the cartilage may be injured. A brief pathophysiology of degenerative disc disease is presented in Figure 53-11.

For most patients, the immediate symptoms of trauma are short-lived, and those resulting from injury to the disc do not appear for months or years. Disc degeneration pushes the capsule back into the spinal canal. It could also rupture and allow the nucleus pulposus to be pushed back against the dural sac or against a spinal nerve as it emerges from the spinal column (see Fig. 53-10B). This disease of the spinal root, produces pain and extreme sensitivity to touch due to radiculopathy (pressure in the area of distribution of the involved nerve endings). Continued pressure may produce degenerative changes in the involved nerve, such as changes in sensation and deep tendon reflexes.

Clinical Manifestations

A herniated disc with accompanying pain may occur in any portion of the spine: cervical, thoracic (rare), or lumbar. The clinical manifestations depend on the location, the rate of development (acute or chronic), and the effect on the surrounding structures.

Assessment and Diagnostic Findings

A thorough health history and physical examination are important to rule out potentially serious conditions that may manifest as low back pain, including fracture, tumor, infection, or cauda equina syndrome (Hickey, 2014).

The MRI scan has become the diagnostic tool of choice for localizing even small disc protrusions, particularly for lumbar spine disease. If the clinical symptoms are not consistent with the pathology seen on MRI, CT scanning and myelography are performed. A neurologic examination is carried out to determine whether reflex, sensory, or motor impairment from root compression is present and to provide a baseline for future assessment. Electromyography may be used to localize the specific spinal nerve roots involved.

Medical Management

Herniations of the cervical and the lumbar discs occur most commonly and are usually managed conservatively with medication and physical therapy or exercise (Hickey, 2014). Surgery is sometimes necessary.

Surgical Management

Surgical excision of a herniated disc is performed if there is evidence of a progressing neurologic deficit (muscle weakness and atrophy, loss of sensory and motor function, loss of sphincter control) and radicular pain (pain that follows the

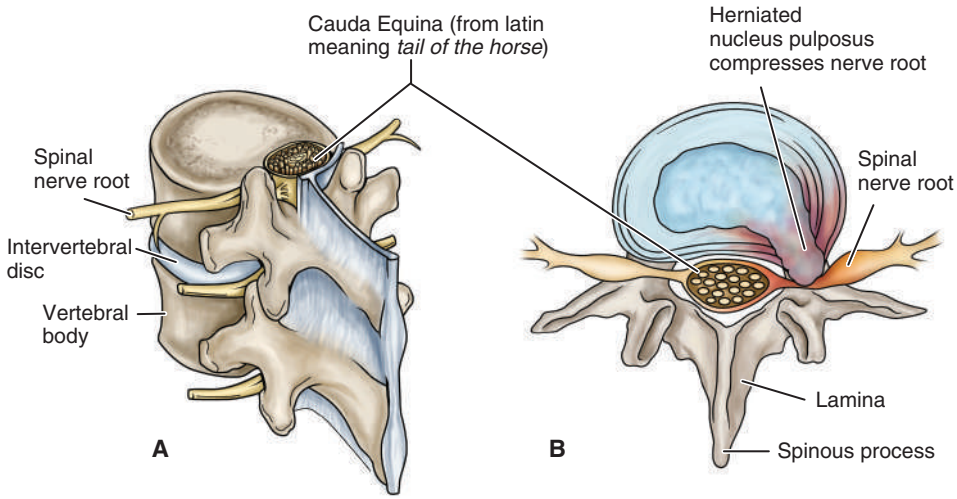


Figure 53-10 • A. Normal lumbar spine vertebrae, intervertebral discs, and spinal nerve root. **B.** Ruptured vertebral disc.

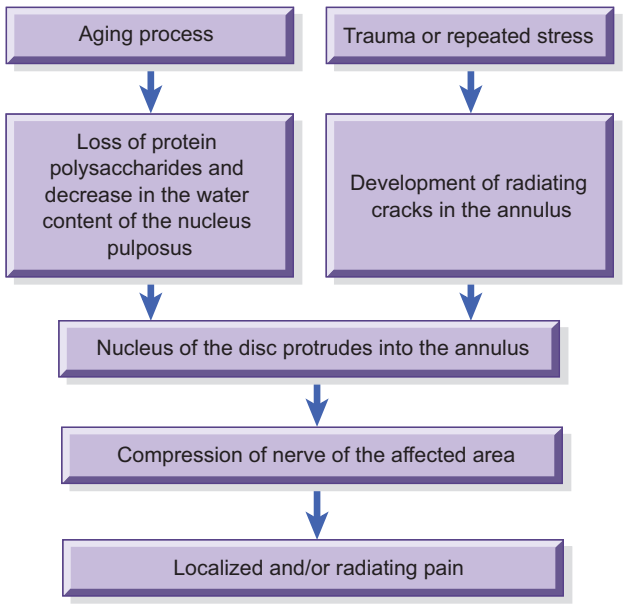


Figure 53-11 • Pathophysiology of degenerative disc disease.

dermatomal distribution [see Fig. 48-9 in Chapter 48] of the compressed nerve) that are unresponsive to conservative management. The goal of surgical treatment is to reduce the pressure on the nerve root to relieve pain and reverse neurologic deficits. Microsurgical techniques make it possible to remove only the amount of tissue that is necessary, which preserves the integrity of normal tissue better and imposes less trauma on the body. During these procedures, spinal cord function can be monitored electrophysiologically.

Some of the surgical techniques available include:

- *Microdiscectomy*: Removal of herniated or extruded fragments of intervertebral disc material
- *Laminectomy*: Removal of the bone between the spinal process and facet pedicle junction to expose the neural elements in the spinal canal (Hickey, 2014); this allows the surgeon to inspect the spinal canal, identify and remove pathologic tissue, and relieve compression of the cord and roots
- *Hemilaminectomy*: Removal of part of the lamina and part of the posterior arch of the vertebra
- *Partial laminectomy or laminotomy*: Creation of a hole in the lamina of a vertebra
- *Discectomy with fusion*: Fusion of the vertebral spinous process with a bone graft (from iliac crest or bone bank), with the object of spinal fusion being to bridge over the defective disc to stabilize the spine and reduce the rate of recurrence
- *Foraminotomy*: Removal of the intervertebral foramen to increase the space for exit of a spinal nerve, resulting in reduced pain, compression, and edema

Herniation of a Cervical Intervertebral Disc

The cervical spine is subjected to stresses that result from disc degeneration (due to aging, occupational stresses) and spondylosis (degenerative changes occurring in a disc and adjacent vertebral bodies). Cervical disc degeneration may lead to lesions that can cause damage to the spinal cord and its roots (Bader et al., 2016).

Clinical Manifestations

A cervical disc herniation usually occurs at the C5–C6 or C6–C7 interspaces and compresses a unilateral nerve root (Bader et al., 2016). Pain and stiffness may occur in the neck, the top of the shoulders, and the region of the scapulae. Patients sometimes interpret these signs as symptoms of heart trouble or bursitis. Pain may also occur in the arm and hand, accompanied by paresthesia (numbness, tingling, or a "pins and needles" sensation) of the upper extremity. Cervical MRI usually confirms the diagnosis. Occasionally, the disc herniates centrally onto the spinal cord, causing Lhermitte syndrome, an electriclike shock sensation in the extremities or spine with neck flexion or straining, and bilateral arm and leg weakness (myelopathy).

Medical Management

The goals of treatment are to rest and immobilize the cervical spine to give the soft tissues time to heal and to reduce inflammation in the supporting tissues and the affected nerve roots in the cervical spine (Hickey, 2014). It also reduces inflammation and edema in soft tissues around the disc, relieving pressure on the nerve roots. Proper positioning on a firm mattress may bring dramatic relief from pain.

The cervical spine may be rested and immobilized by a cervical collar, cervical traction, or a brace. A collar allows maximal opening of the intervertebral foramina and holds the head in a neutral or slightly flexed position. The patient may have to wear the collar 24 hours a day during the acute phase. The skin under the collar is inspected for irritation. After the patient is free of pain, cervical isometric exercises are started to strengthen the neck muscles.

Pharmacologic Therapy

Analgesic agents (nonsteroidal anti-inflammatory agents [NSAIDs], acetaminophen (paracetamol)/oxycodone [Tylox], or acetaminophen (paracetamol)/hydrocodone [Vicodin]) are prescribed during the acute phase to relieve pain, and sedative agents may be given to control the anxiety that is often associated with cervical disc disease. Muscle relaxants (cyclobenzaprine [Flexeril], methocarbamol [Robaxin], metaxalone [Skelaxin]) are given to interrupt muscle spasm and to promote comfort. NSAIDs (aspirin, ibuprofen [Motrin, Advil], naproxen [Naprosyn, Anaprox]) or corticosteroids are prescribed to treat the inflammation and swelling that usually occurs in the affected nerve roots and supporting tissues. Occasionally, a corticosteroid is injected into the epidural space for relief of radicular (spinal nerve root) pain. NSAIDs are given with food to prevent gastrointestinal irritation (Comerford, 2015). Hot, moist compresses (for 10 to 20 minutes) applied to the back of the neck several times daily increase blood flow to the muscles and help relax the patient and reduce muscle spasm. Nonpharmacologic interventions such as guided imagery, biofeedback, and relaxation provide relief as well (Abdulla, Adams, Bone, et al., 2013).

Surgical Management

Surgical excision of the herniated disc may be necessary if there is a significant neurologic deficit, progression of the deficit, evidence of cord compression, or pain that either worsens or fails to improve. A cervical discectomy, with or without fusion, may be performed to alleviate symptoms. An anterior surgical approach may be used through a transverse incision to remove disc material that has herniated into the spinal canal and foramina, or a posterior approach may be

used at the appropriate level of the cervical spine. Potential complications with the anterior approach include carotid or vertebral artery injury, recurrent laryngeal nerve dysfunction, esophageal perforation, and airway obstruction (Hickey, 2014). Complications of the posterior approach include damage to the nerve root or the spinal cord due to retraction or contusion of either of these structures, resulting in weakness of muscles supplied by the nerve root or cord.

Microsurgery, such as endoscopic microdiscectomy, may be performed in selected patients through a small incision, using magnification techniques. This usually results in less tissue trauma and pain, and patients consequently have a shorter length of hospital stay compared with those who have conventional surgery (Hickey, 2014).

NURSING PROCESS

The Patient Undergoing a Cervical Discectomy

Assessment

The patient is asked about past injuries to the neck (whiplash), because unresolved trauma can cause persistent discomfort, pain and tenderness, and symptoms of arthritis in the injured joint of the cervical spine. Assessment includes determining the onset, location, and radiation of pain and assessing for paresthesias, limited movement, and diminished function of the neck, shoulders, and upper extremities. It is important to determine whether the symptoms are bilateral; with large herniations, bilateral symptoms may be caused by cord compression. The area around the cervical spine is palpated to assess muscle tone and tenderness. Range of motion in the neck and shoulders is evaluated.

The patient is asked about any health issues that may influence the postoperative course and quality of life. It is also important to assess mood and stress levels. The nurse determines the patient's need for information about the surgical procedure and reinforces what the primary provider has explained. Strategies for pain management are discussed with the patient (Hickey, 2014).

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Acute pain related to the surgical procedure
- Impaired physical mobility related to the postoperative surgical regimen
- Deficient knowledge about the postoperative course and home care management

Other nursing diagnoses may include preoperative anxiety, postoperative constipation, urinary retention related to the surgical procedure, self-care deficits related to use of a neck orthosis, and sleep pattern disturbance related to disruption in lifestyle.

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Hematoma at the surgical site, resulting in cord compression and neurologic deficit
- Recurrent or persistent pain after surgery

Planning and Goals

The goals for the patient may include relief of pain, improved mobility, increased knowledge and self-care ability, and prevention of complications.

Nursing Interventions

Relieving Pain

Incisional pain is expected. Radicular pain improves over time as the nerve recovers. If the patient has had a bone fusion with bone removed from the iliac crest, considerable pain may be experienced at the donor site. Interventions consist of monitoring the donor site for hematoma formation, administering the prescribed postoperative analgesic agent, positioning for comfort, and reassuring the patient that the pain can be relieved. If the patient experiences a sudden increase in pain, extrusion of the graft may have occurred, requiring reoperation. A sudden increase in pain should be promptly reported to the surgeon (Hickey, 2014).

The patient may experience a sore throat, hoarseness, and dysphagia due to temporary edema. These symptoms are relieved by throat lozenges, voice rest, and humidification. A pureed diet may be given if the patient has dysphagia.

Improving Mobility

Postoperatively, a cervical collar (neck orthosis) may be worn, which contributes to limited neck motion and altered mobility. The patient is instructed to turn the body instead of the neck when looking from side to side. The neck should be kept in a neutral (midline) position. The patient is assisted during position changes to make sure that the head, shoulders, and thorax are kept aligned. When assisting the patient to a sitting position, the nurse supports the patient's neck and shoulders. To increase stability, the patient should wear shoes when ambulating. The patient is encouraged not to lift more than 4.5 kg.

Monitoring and Managing Potential Complications

The patient is evaluated for bleeding and hematoma formation by assessing for swelling, excessive pressure in the neck, or severe pain in the incision area. The dressing is inspected for serosanguineous drainage, which suggests a dural leak. If this occurs, meningitis is a threat. A complaint of headache requires careful evaluation. Neurologic checks are made for swallowing deficits and upper and lower extremity weakness, because cord compression may produce rapid or delayed onset of paralysis (Hickey, 2014). The patient who has had an anterior cervical discectomy is also assessed for a sudden return of radicular (spinal nerve root) pain, which may indicate instability of the spine (AANN, 2014c).

Throughout the postoperative course, the patient is monitored frequently to detect any signs of respiratory difficulty, because retractors used during surgery may injure the recurrent laryngeal nerve, resulting in hoarseness and the inability to cough effectively and clear pulmonary secretions. In addition, the blood pressure and pulse are monitored to evaluate cardiovascular status and optimal circulation to the surgical site.

Bleeding at the surgical site and subsequent hematoma formation may occur. Severe localized pain not relieved by analgesic agents should be reported. A change in neurologic status (motor or sensory function) should be reported promptly, because it suggests hematoma formation that may necessitate surgery to prevent irreversible motor and sensory deficits (Hickey, 2014).

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. The patient's length of hospital stay is likely to be short; therefore, the patient and family should understand the care that is important for a smooth recovery. A cervical collar, if prescribed, is usually worn for about 6 weeks. The patient is educated in the use and care of the cervical collar. The patient will need to alternate tasks that

involve minimal body movement (e.g., reading) with tasks that require greater body movement.

The patient is educated about strategies to manage the incision and to manage pain, and about signs and symptoms that may indicate complications that should be reported to the primary provider. The nurse assesses the patient's understanding of these management strategies, limitations, and recommendations. In addition, the nurse assists the patient in identifying strategies to cope with ADLs (e.g., self-care, child care) and minimize risks to the surgical site (see Chart 53-6). A discharge educational plan is developed collaboratively by members of the health care team to decrease the risk of recurrent disc herniation. Topics include those previously discussed as well as proper body mechanics, maintenance of optimal weight, proper exercise techniques, and modifications in activity.

Continuing and Transitional Care. The patient is instructed to see the primary provider at prescribed intervals so that the provider can document the disappearance of old symptoms and assess the range of motion of the neck. Recurrent or persistent pain may occur despite removal of the offending disc or disc fragments. Patients who undergo discectomy usually have consented to surgery after prolonged pain; they have often undergone repeated courses of ineffective conservative management and previous surgeries to relieve the pain. Therefore, the recurrence or persistence of symptoms postoperatively, including pain and sensory deficits, is often discouraging for the patient and family. The patient who experiences recurrence of symptoms requires emotional support and understanding. In addition, the patient is assisted in modifying activities and in considering options for subsequent treatment. The nurse educates the patient and family members about the need to participate in health-promotion and health-screening practices.

Evaluation

Expected patient outcomes may include:

1. Reports decreasing frequency and severity of pain
2. Demonstrates improved mobility
   a. Demonstrates progressive participation in self-care activities
   b. Identifies prescribed activity limitations and restrictions
   c. Demonstrates proper body mechanics
3. Is knowledgeable about postoperative course, medications, and home care management
   a. Lists the signs and symptoms to be reported postoperatively
   b. Identifies dose, action, and potential side effects of medications
   c. Identifies appropriate home care management activities and any restrictions
4. Has absence of complications
   a. Reports no increase in incision pain or sensory symptoms
   b. Demonstrates normal findings on neurologic assessment

Chart 53-6 HOME CARE CHECKLIST

The Patient with Cervical Discectomy and Cervical Collar

At the completion of education, the patient and/or caregiver will be able to:

- Name the procedure that was performed and identify any permanent changes in anatomic structure or function as well as changes in ADLs, IADLs, roles, relationships, and spirituality.
- Identify interventions and strategies (e.g., durable medical equipment, adaptive equipment) used in adapting to any permanent changes in structure or function to promote safety and optimum functioning.
  - Use adequate mattress and chair support.
- State the name, dose, side effects, frequency, and schedule for all medications.
  - Describe nonpharmacologic interventions for pain relief used in conjunction to prescribed pain relief preparations.
- State how to obtain medical supplies and carry out dressing changes, wound care, and other prescribed regimens.
- State how to contact all members of the treatment team (e.g., health care providers, home care professionals, and durable medical equipment and supply vendor).
- Describe ongoing postoperative therapeutic regimen, including diet and activities to perform (e.g., exercises) and to limit or avoid (e.g., lifting, stair climbing, driving a car) during rehabilitation.
- Describe care for the surgical incision site.
  - Keep staples or sutures clean and dry and cover with dry dressing.
- Demonstrate proper body mechanics and prescribed exercise techniques.
  - Describe how to modify activity for optimum functioning.
  - Avoid sitting or standing for more than 30 minutes.
  - Avoid twisting, flexing, extending, or rotating the neck.
  - Avoid sleeping in a prone position or the use of pillows to minimize neck flexion in bed; keep head in a neutral position.
  - Wear low-heeled shoes.
  - Place a wrinkle-free silk scarf under the collar to increase comfort.
  - **For men**: Shave without twisting or moving the neck. This may be done with help while lying flat or sitting. Remove only the front part of the collar for shaving.
- Practice stress reduction and relaxation techniques.
- Care of the cervical collar:
  - Wear the collar at all times until directed otherwise by the primary provider.
  - Wash the neck under the collar twice a day with mild soap.
  - Keep the neck still while the collar is open.
  - With the assistance of a helper, wash the neck in steps.
  - Lie flat and supine.
  - Open the Velcro tabs on each side of the collar and remove its front portion.
  - Gently wash and dry the neck.
  - Replace the front part of the collar and refasten the tabs.
  - Turn to one side with a thin pillow under the head.
  - Open one tab.
  - Gently wash and dry the back of the neck. Refasten the tab.
  - Turn to the other side and wash and dry this side. Refasten the tab.
- Notify primary provider if any signs or symptoms of infection occur, such as fever, redness or irritation, drainage, increased pain.
- Relate how to reach primary provider with questions or complications.
- State time and date of follow-up medical appointments, therapy, and testing.
- Identify sources of support (e.g., friends, relatives, faith community, support groups, caregiver support).
- Identify the need for health promotion, disease prevention, and screening activities.

ADL, activities of daily living; IADL, independent activities of daily living.

Herniation of a Lumbar Disc

Most lumbar disc herniations occur at the L5–S1 region (AANN, 2014d). A herniated lumbar disc produces low back pain accompanied by varying degrees of sensory and motor impairment.

Clinical Manifestations

The patient complains of low back pain with muscle spasm and sciatica (pain and tenderness that radiates along the sciatic nerve that runs through the thigh and leg). Pain is aggravated by actions that increase intraspinal fluid pressure, such as bending, lifting, or straining (as in sneezing or coughing), and usually is relieved by bed rest. There is often some type of postural deformity, because pain causes an alteration of the normal spinal mechanics. If the patient lies on the back and attempts to raise a leg in a straight position, pain radiates into the leg; this maneuver, called the *straight-leg raising test,* stretches the sciatic nerve. Additional signs include muscle weakness, alterations in tendon reflexes, and sensory loss.

Assessment and Diagnostic Findings

The diagnosis of lumbar disc disease is based on the history and physical findings, specifically the location, quality, severity of pain, and the use of imaging techniques such as MRI and CT scans as well as myelography.

Medical Management

The objectives of treatment are to relieve pain, slow disease progression, and increase the patient's functional ability (AANN, 2014d). Bed rest is discouraged because it may weaken muscles, but activities that exacerbate pain should be avoided.

Because muscle spasm is prominent during the acute phase, muscle relaxants are used. NSAIDs and systemic corticosteroids may be given to counter the inflammation and swelling that usually occurs in the supporting tissues and the affected nerve roots. Moist heat and massage help relax muscles. Strategies for increasing the patient's functional ability include weight reduction, physical therapy, and biofeedback. Exercises, prescribed by physical therapists, can help strengthen back muscles and decrease pain (Hickey, 2014). See Chapter 9 for descriptions of nursing interventions for the patient with pain.

Surgical Management

In the lumbar region, surgical treatment includes lumbar disc excision through a posterolateral laminotomy and the techniques of microdiscectomy and percutaneous discectomy. In microdiscectomy, an operating microscope is used to visualize the offending disc and compressed nerve roots; it permits a small incision (2.5 cm [1 inch]) and minimal blood loss and takes about 30 minutes of operating time. In general, the length of hospital stay is short, and the patient makes a rapid recovery. Several minimally invasive techniques in spinal surgery have led to improved patient outcomes and lower hospital costs, and research on these techniques is ongoing. Fusion is considered when vertebral instability is present and contributes to pain. Fusion procedures are longer and cause more postoperative pain. Research suggests that intraoperative wound infiltration with bupivacaine hydrochloride solution decreases pain and the need for opioids postoperatively. Some studies suggest that gel substances for disc replacement may decrease pain and improve spinal function.

A patient undergoing a disc procedure at one level of the vertebral column may have a degenerative process at other levels. A herniation relapse may occur at the same level or elsewhere, so the patient may become a candidate for another disc procedure. Arachnoiditis (inflammation of the arachnoid membrane) may occur after surgery (and after myelography); it involves an insidious onset of diffuse, frequently burning pain in the lower back, radiating into the buttocks. Disc excision can leave adhesions and scarring around the spinal nerves and dura, which then produce inflammatory changes that create chronic neuritis and neurofibrosis. Disc surgery may relieve pressure on the spinal nerves, but it does not reverse the effects of neural injury and scarring and the pain that results. Failed disc syndrome (recurrence of sciatica after lumbar discectomy) remains a cause of disability (Hickey, 2014).

Nursing Management

Providing Preoperative Care

Most patients fear surgery on any part of the spine and therefore need explanations about the surgery and reassurance that it will not weaken the back. When data are being collected for the health history, any reports of pain, paresthesia, or muscle spasm are recorded to provide a baseline for comparison after surgery. Health issues that may influence the postoperative course and quality of life (e.g., fatigue, mood, stress, patient expectations, smoking) are important to assess. Preoperative assessment also includes an evaluation of movement of the extremities as well as bladder and bowel function (Hickey, 2014). To facilitate the postoperative turning procedure, the patient is instructed to turn as a unit (called logrolling) as part of the preoperative preparation (see Fig. 53-12). Before surgery, the patient is also encouraged to take deep breaths, cough, and perform muscle setting exercises to maintain muscle tone.



Figure 53-12 • Before the patient undergoes laminectomy surgery, the logrolling technique that will be used for turning the patient should be demonstrated. The patient's arms will be crossed and the spine aligned. To avoid twisting the spine, the head, shoulders, knees, and hips are turned at the same time so that the patient rolls over like a log. When in a side-lying position, the patient's back, buttocks, and legs are supported with pillows.

Assessing the Patient after Surgery

After lumbar disc excision, vital signs are checked frequently and the wound is inspected for hemorrhage, because vascular injury is a complication of disc surgery. Because postoperative neurologic deficits may occur from nerve root injury, the sensation and motor strength of the lower extremities are evaluated at specified intervals, along with the color and temperature of the legs and sensation of the toes. It is important to assess for urinary retention, which is another sign of neurologic deterioration (AANN, 2014d). In discectomy with fusion, the patient has an additional surgical incision if bone fragments were taken from the iliac crest or fibula to serve as wedges in the spine. The recovery period is longer than for those patients who underwent discectomy with spinal fusion, because bony union must take place.

Positioning the Patient

To position the patient, a pillow is placed under the head, and the knee rest is elevated slightly to relax the back muscles. When the patient is lying on one side, however, extreme knee flexion must be avoided. The patient is encouraged to move from side to side to relieve pressure and is reassured that no injury will result from moving. When the patient is ready to turn, the bed is placed in a flat position and a pillow is placed between the patient's legs. The patient turns as a unit (logrolls) without twisting the back.

To get out of bed, the patient lies on one side while pushing up to a sitting position. At the same time, the nurse or family member eases the patient's legs over the side of the bed. Coming to a sitting or standing posture is accomplished in one long, smooth motion. Most patients walk to the bathroom on the same day as the surgery. Sitting is discouraged except for defecation.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

The patient is instructed to increase activity gradually, as tolerated, because it takes up to 6 weeks for the ligaments to heal. Excessive activity may result in spasm of the paraspinal muscles (Hickey, 2014).

Activities that produce flexion strain on the spine (e.g., driving a car) should be avoided until healing has taken place. Heat may be applied to the back to relax muscle spasms. Scheduled rest periods are important, and the patient is advised to avoid heavy work for 2 to 3 months after surgery. Exercises are prescribed to strengthen the abdominal and erector spinal muscles. A back brace or corset may be necessary if back pain persists.

Continuing and Transitional Care

Referral for inpatient or outpatient rehabilitation may be warranted to improve self-care abilities after medical or surgical treatment for herniation of a lumbar disc. A home care referral may be indicated and provides the nurse with the opportunity to assess the patient's physical and psychological status, as well as their ability to adhere to recommended management strategies. During the home visit, the nurse determines whether changes in neurologic function have occurred. The adequacy of pain management is assessed, and modifications are made to ensure adequate pain relief.

Lower back pain can be debilitating and costly. The use of electronic medical records may help physicians identify this earlier so they can develop plans to manage patients differently based on the number of times they seek health care.

Post-Polio Syndrome

Polio has mostly been eradicated globally due to concerted efforts on vaccination. However, people who survived the polio epidemic of the 1950s, many of whom are now older adults, are developing new symptoms of weakness, fatigue, and musculoskeletal pain identified as PPS. This phenomenon, which occurs 30 to 40 years after the polio exposure, affects 25% to 40% of all survivors of polio who were either immediately disabled or who recovered with few or no symptoms (Groce, Banks, & Stein, 2014). Men and women appear to be equally at risk for this condition.

Pathophysiology

The exact cause of PPS is not known, but researchers suspect that with aging or muscle overuse, the neurons not destroyed by the poliovirus continue generating axon sprouts (Woodward, 2014). These new terminal axon sprouts reinnervate the affected muscles after the initial insult but may become more vulnerable as the body ages.

Assessment and Diagnostic Findings

No specific diagnostic test exists for PPS. Clinical diagnosis is made on the basis of the history and physical examination and exclusion of other medical conditions that could be causing the new symptoms. Patients report a history of paralytic poliomyelitis followed by partial or complete recovery of function, with a plateau of function and then the recurrence of symptoms. Signs and symptoms may occur decades after the original onset of poliomyelitis (Woodward, 2014).

Management

No specific medical or surgical treatment is available for this syndrome, and therefore nurses play a pivotal role in the team approach to assisting patients and families in dealing with the symptoms of progressive loss of muscle strength and significant fatigue (McNalley, Yorkston, Jensen, et al., 2015). Pain and weakness may be improved with infusion of intravenous immunoglobulin (Woodward, 2014).

The procedural guideline for managing immunoglobulin therapy is discussed in Procedural Guidelines 53-1.

Other health care professionals who may assist in patient care include physical, occupational, speech, respiratory therapists, social workers, and nurses. Nursing interventions are aimed at maintaining the patient's strength as well as physical, psychological, and social well-being.

The patient needs to plan and coordinate activities to conserve energy and reduce fatigue. Rest periods should be planned and assistive devices used to reduce weakness and fatigue. Important activities should be planned for the morning, because fatigue often increases in the afternoon and evening.

Pain in muscles and joints may be a problem. Nonpharmacologic techniques such as the application of heat and cold are most appropriate, because older patients may not tolerate or may have strong reactions to medications.

Maintaining a balance between adequate nutritional intake and avoiding excess calories that can lead to obesity is a challenge in this group of patients who are sedentary. Pulmonary hygiene and adequate fluid intake can help with airway management. Several interventions can improve sleep, including limiting caffeine intake before bedtime and assessing for nocturia. The patient

Procedural Guidelines 53-1

Managing Immunoglobulin Therapy

Immunoglobulin therapy is an important treatment for a variety of disease states that are characterized by deficient production of antibodies. Immunoglobulin can be administered for replacement therapy as an IV infusion or subcutaneous (SQ) injection. It can safely be administered in outpatient as well as inpatient settings.

Equipment (as Needed)

- Single-use tourniquet
- Single-use scissors or clippers for hair removal
- IVIG solution, tubing, connector, catheter, or syringe
- Chlorhexidine gluconate, povidone–iodine, or alcohol swabs
- Nonlatex gloves
- Transparent dressing, bandage, or sterile gauze
- Padded, appropriate-length arm board
- Tape
- Topical analgesics
- Preservative-free 0.9% NaCl flush solution
- Padded, appropriate-length arm board or finger splint
- Electronic infusion pump

Implementation

Nursing Actions	Rationale
1. Verify prescription for IVIG therapy and identify patient.	1. Serious errors can be avoided by careful checking. Immunoglobulin is supplied in a 5% solution or a lyophilized powder with a reconstituting diluent prepared from Cohn fraction II obtained from pools of 1,000–20,000 donors. Currently, a number of different IV preparations are approved for use and have been shown to be effective and safe by the U.S. Food and Drug Administration. Immunoglobulin can also be administered via SQ injection.
2. Check for allergies (i.e., latex, iodine).	2. Checking for allergies reduces risk of allergic reaction.
3. Explain procedure to patient.	3. Knowledge increases patient comfort and cooperation.
4. Perform hand hygiene, and put on disposable nonlatex gloves.	4. Asepsis is essential to prevent infection. The use of nonlatex gloves prevents exposure of nurse to patient's blood and of patient and nurse to latex.
5. Obtain Ht. and Wt. of patient before treatment.	5. Obtaining Ht. and Wt. helps verify accurate dosing.
6. Assess baseline vital signs before, during, and after treatment.	6. An elevated temperature at the beginning of treatment may be an indication to delay the therapy to avoid misinterpreting this as an adverse reaction.
7. Premedicate with acetaminophen / paracetamol (Tylenol) and diphenhydramine (Benadryl) as prescribed 30 minutes before the start of infusion therapy. Corticosteroids may be prescribed as well.	7. Premedicating may help avert adverse reactions. Corticosteroids may be used to prevent possible severe reactions in patients who are perceived to be at risk.
8. Verify the route and dose of IVIG therapy.	8. IVIG can be administered via the IV or SQ routes. The optimal dose is determined by the patient's response. In most instances, an IV dose of 200–800 mg/kg of body weight is administered every 3–4 weeks to ensure adequate serum levels of immunoglobulin G (IgG).
9. Insert IV cannula or catheter according to Guidelines for Starting a Peripheral Intravenous Infusion, as needed.	9. Patient may need IV access, may have a port or long-term catheter for an IV infusion.
10. Administer the IV infusion at a slow rate, not to exceed 3 mL/min, usually at 100–200 mL/h.	10. Administer according to manufacturer's instructions. Beginning at a slow rate helps minimize adverse reactions.
11. Continually assess the patient for adverse reactions.	11. Be aware of complaints of a tickle or lump in the throat as the precursor to laryngospasm that precedes bronchoconstriction. Caution should be exercised when changing IVIG products, because they are not biologically equivalent. Understand that long-term tolerance of an older IVIG product does not necessarily imply tolerance to a newer product, even if it is technically superior.
12. Stop IV infusion at the first sign of reaction.	12. Initiate the institutional protocol to be followed in an emergent situation. Patients who have an IgA deficiency have IgE antibodies to IgA, which requires administration of plasma or immunoglobulin replacement from IgA-deficient patients. Because all IV immunoglobulin preparations contain some IgA, they may cause an anaphylactic reaction in patients with IgE anti-IgA antibodies.
13. Administer SQ immunoglobulin as orders.	13. The pharmacokinetics of IgG differ when smaller doses are given more frequently, as is commonly done with SQ regimens.

Ht., height; Wt., weight.

Adapted from Cherin, P., Marie, I., Michallet, M., et al. (2016). Management of adverse events in the treatment of patients with immunoglobulin therapy: A review of evidence. Autoimmunity Reviews, 15, 71–81.

may need to be evaluated for obstructive sleep apnea. Supportive ventilation may be appropriate, with continuous positive airway pressure if sleep apnea is a problem (see Chapter 40).

Bone density testing in patients with PPS has revealed low bone mass and osteoporosis. Therefore, the importance of identifying risks, preventing falls, and treating osteoporosis must be discussed with patients and families. Families also need to be made aware of the possibility of changes in individual and family relationships due to the many symptoms of PPS. The nurse also needs to remind patients and family members of the need for health-promotion activities and health screening (Woodward, 2014).

CRITICAL THINKING EXERCISES

1. A 34-year-old woman, working, married, with three children has been newly diagnosed with a spinal cord tumor. Assess and prioritize the patient's physiologic and psychosocial needs. What nursing interventions and actions would you suggest to assist in managing the treatment of and coping with a spinal cord tumor? How would this be different if the patient lives alone?
2. A 65-year-old man is newly diagnosed with ALS. Identify the evidence-based practices for the management of ALS. Describe the evidence base for the practices that you have identified and the criteria used to evaluate the strength of that evidence. Identify the health-promotion activities you would recommend to this patient and the rationale for your recommendations.
3. A 72-year-old woman is admitted for low back pain that radiates down her leg. What are your priorities for providing care for this patient? Give your rationale. What further diagnostic testing is needed? How will your priorities change if the patient is scheduled for back surgery?

REFERENCES

*Asterisk indicates nursing research.

Books

American Association of Neuroscience Nurses (AANN). (2014a). Care of the adult patient with a brain tumor: AANN clinical practice guideline series. Chicago, IL: Author.

American Association of Neuroscience Nurses (AANN). (2014b). Care of movement disorder patient with deep brain stimulation: AANN clinical practice guideline series. Chicago, IL: Author.

American Association of Neuroscience Nurses (AANN). (2014c). Cervical spine surgery: A guide to preoperative and postoperative patient care: AANN clinical practice guideline series. Chicago, IL: Author.

American Association of Neuroscience Nurses (AANN). (2014d). Thoracolumbar spine surgery: A guide to preoperative and postoperative care: AANN clinical practice guideline series. Chicago, IL: Author.

Bader, M., Littlejohns, L. R., & Olson, D. (2016). AANN core curriculum for neuroscience nursing (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Brant, W. E., & Helms, C. A. (2006). Fundamentals of diagnostic radiology (3rd ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Dalton, J., & Sampson, J. B. (2015). Chapter 18. Overview of adult muscular dystrophies. In: Genetic counseling for adult neurodegenerative disease. New York: Springer Science and Business.

Eliopoulos, C. (2018). Gerontological nursing (9th ed.). Philadelphia, PA: Wolters Kluwer.

Hickey, J. V. (2014). The clinical practice of neurological & neurosurgical nursing (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

Abbruzzese, G., Marchese, R., Avanizino, L., et al. (2016). Rehabilitation for Parkinson's disease: Current outlook and future challenges. Parkisonism and Related Disorders,22(1), S60–S64.

Abdulla, A., Adams, N., Bone, M., et al. (2013). Guidance on management of pain in older people. Age and Aging, 42(1), 1–57.

American Brain Tumor Association (ABTA) (2014). *Brain tumor statistics*. Retrieved on 2/23/17 at: www.abta.org/about-us/news/brain-tumor-statistics/

Banerjee, A., Jadhav, S. L., & Bhawalkar, J. S. (2012). Limitations of activities in patients with musculoskeletal disorders. Annals of Medical and Health Sciences Research, 2(1), 5–9.

Barboza, L. A., & Ghisi, N. C. (2018). Evaluating the current state of the art of Huntington disease research: a scientometric analysis. Brazilian Journal of Medical and Biological Research, 51(3), e6299. Retrieved on http://dx.doi.org/10.1590/1414-431X20176299 on 14th May 2018.

Bastos, A. F., Orsini, M., Machado, D., Mello, M. P., Nader, S., Silva, J. G., Pessoa, L. L. (2011). Amyotrophic lateral sclerosis: one or multiple causes? Neurology International, 3(1).

Bellomo, T., & Cichminski, L. (2015). Amyotrophic lateral sclerosis: What nurses need to know. Nursing, 45(10), 47–51.

Bhat, A. R., Kirmani, A. R., Wani, M. A., & Bhat, M. H. (2016). Incidence, histopathology, and surgical outcome of tumors of spinal cord, nerve roots, meninges, and vertebral column - Data based on single institutional (Sher-i-Kashmir Institute of Medical Sciences) experience. Journal of Neurosciences in Rural Practice, *7*(3), 381–91. https://doi.org/10.4103/0976-3147.181489

Bihari, V., Kesavachandran, C., Pangtey, B. S., Srivastava, A. K., & Mathur, N. (2011). Musculoskeletal pain and its associated risk factors in residents of National Capital Region. Indian Journal of Occupational and Environmental Medicine, 15(2), 59.

Carletti, S., Rispoli, R., Di Chirico, A., et al. (2016). Neural stem cells transplantation as a neuroprotective strategy for amyotrophic lateral sclerosis (ALS). Global Spine Journal, 6(Suppl 1), 1–20.

Chopra, A., Patil, J., Billempelly, V., Relwani, J., & Tandle, H. S. (2001). Prevalence of rheumatic diseases in a rural population in western India: a WHO-ILAR COPCORD Study. The Journal of the Association of Physicians of India, 49, 240–246.

Cone, L. A., Nazemi, R., & Cone, M. O. (2002). Reversible ALS-like disorder in HIV infection An ALS-like syndrome with new HIV infection and complete response to antiretroviral therapy. Neurology, 59(3), 474–475.

Das, S. K., Misra, D. A. K., Ray, D. B. K., Hazra, D. A., Ghosal, M. K., Chaudhuri, A., Raut, F. D. K. (n.d.). (2010). Epidemiology of Parkinson disease in the city of Kolkata, India A community-based study. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3013482/pdf/8105.pdf

Dhandapani, M., Gupta, S., Dhandapani, S., et al. (2015). Study of factors determining caregiver burden among primary caregivers of patients with intracranial tumors. Surgical Neurology International,6, 160.

Duraiswamy, N. (2009). Musculardystrophy - Rare Diseases India. Retrieved March 17, 2018, from http://www.rarediseasesindia.org/musculardystrophy

Farge, D. (2013). International clinical practice guidelines for the treatment and prophylaxis of venous thromboembolism in patients with cancer. Journal of Thrombosis and Haemostasis, 11(1), 56–70.

Ferraiuolo, L., De Bono, J. P., Heath, P. R., Holden, H., Kasher, P., Channon, K. M., … Shaw, P. J. (2009). Transcriptional response of the neuromuscular system to exercise training and potential implications for ALS. Journal of Neurochemistry, 109(6), 1714–1724.

Ferrer, I. (2016). Mini-symposium: Huntington's disease. Brain Pathology, 26(6), 724–725.

Gallego Perez-Larrraya, J., & Delattre, J. Y. (2014). Management of the elderly patient with gliomas. Oncologist, 19(12), 1258–1267.

Gopalakrishna, A., & Alexander, S. A. (2015). Understanding Parkinson disease: A complex and multifaceted illness. Journal of Neuroscience Nursing, 47(6), 320–326.

Graham, C. D., Weinman, J., Sadjadi, R., et al. (2014). A multicentre postal survey investigating the contribution of illness perceptions, coping and

optimism to quality of life and mood in adults with muscle disease. Clinical Rehabilitation, 28(5), 508–519.
Groce, N. E., Banks, L. M., & Stein, M. A. (2014). Surviving polio in a post-polio world. Social Science and Medicine, 107, 171–178.Kalia, L. V., & Lang, A. E. (2015). Parkinson's disease. Lancet, 386(9996), 896–912.
Gupta, B. M., Bala, A., & Bala, M. A. (n.d.). Parkinson's disease in India: An analysis of publications output during 2002-2011. *International Journal of Nutrition Pharmacology*, *3*. https://doi.org/10.4103/2231-0738.114849
Haldiya, K. R., Mathur, M. L., Mathur, N. C., & Mathur, A. (2009). Epidemiology of Musculoskeletal Conditions in India. Retrieved from http://dmrcjodhpur.nic.in/AR09-10/P2-1.pdf
Jalali, R., & Datta, D. (2008). Prospective analysis of incidence of central nervous tumors presenting in a tertiary cancer hospital from India. Journal of Neuro-Oncology, 87(1), 111.
Jubelt, B., & Drucker, J. (1999). Poliomyelitis and the post-polio syndrome. Motor Disorders. Lippincott Williams & Wilkins, Philadelphia, 381–395.
Kang, P. B., Morrison, L., Iannaccone, S. T., et al. (2015). Evidence-based guideline summary: Evaluation, diagnosis, and management of congenital muscular dystrophy: Report of the Guideline Development Subcommittee of the American Academy of Neurology and the Practice Issues Review Panel of the American Association of Neuromuscular & Electrodiagnostic Medicine. Neurology, 84(13), 1369–1378.
Kim, S. U., Lee, H., & Kim, Y. B. (2013). Neural stem cell-based treatment for neurodegenerative diseases. Neuropathology, 33(5), 491–501.
Kumar, A., Singh, S. K., Kumar, V., et al. (2015). Huntington's disease: An update of therapeutic strategies. Gene, 556(2), 91–97.
LaDonna, K. A., Koopman, W. J., Ray, S. L., et al. (2016). Hard to swallow: A phenomenological exploration of the experience of caring for individuals with myotonic dystrophy and dysphagia. Journal of Neuroscience Nursing, 48(1), 42–51.
Lovely, M. P., Stewart-Amidei, C., Page, M., et al. (2013). A new reality: Long term survivorship with a malignant brain tumor. Oncology Nursing Forum, 40(3), 267–274.
Lukas, R. V., Buerki, R., & Mrugula, M. M. (2016). Management of leptomeningeal disease from solid tumors. Oncology, 30(8), 724–730.
Majmuder, S., Wu, J., & Paganoni, S. (2014). Rehabilitation in amyotrophic lateral sclerosis: Why it matters. Muscle Nerve, 50, 4–13.Marchetti, B. (2014). Act fast when new neurologic deficits arise. American Nurse Today, 9(1), 12.
*Martin, S. C. (2015). Psychosocial challenges experienced by partners of people with Parkinson disease. Journal of Neuroscience Nursing, 47(4), 211–222.
McNalley, E., Yorkston, K. M., Jensen, M., et al. (2015). A review of secondary health conditions in post-polio syndrome. American Journal of Physical Medicine & Rehabilitation, 94(2), 139–145.
Melmed, S. (2016). Pituitary medicines from discovery to patient focused outcomes. Journal of Clinical Endocrinology and Metabolism, 101(3), 769–779.
Mercuri, E., & Muntoni, F. (2013). New challenges and review of the current clinical trials. Current Opinion in Pediatrics, 25(6), 701–707.
Moore, D. J., Smith, B. M., & Cho, M. H. (2017). Managing meditations for hospital patients with Parkinson disease. American Nurse Today, 12(1), 9–12.
Muthane, U. (2008). Movement Disorders in India. *Advances in Clinical Neuroscience and Rehabilitation*, *8*(2), 22–23.
Muthane, U., Jain, S., & Gururaj, G. (2001). Hunting genes in Parkinson's disease from the roots. Medical Hypotheses, *57*(1), 51–55.
Nair, M. K., Varghese, C., & Swaminathan, R. (2015). Cancer: Current scenario, intervention strategies and projections for 2015. *NCHM Background Papers-Burden of Disease in India*, 219–225.
Nandakumar, A., & Ramnath, T. (2009). Consolidated report of Hospital based registries 2004-2006. National Cancer Registry Programme, Indian Council for Medical Research, Bangalore, India, 54.
Ostrom, Q. T., Gittleman, H., Fulop, J., et al. (2015). CBTRUS statistical report: Primary brain and central nervous system tumors diagnosed in the United States in 2008–2012. Journal of Neuro-Oncology, 17(Suppl 4), 1–63.
Ownsworth, T., Goadby, E., & Chambers, S. K. (2015). Support after brain tumor means different things: Family caregivers' experiences of support and relationship changes. Frontiers in Oncology, 5(33), 1–13.
Perkins, A., & Liu, G. (2016). Primary brain tumors in adults: Diagnosis and treatment. American Family Physician, 93(3), 211–217.
Piredda, M., Matarese, M., Mastroianni, C., et al. (2015). Adult patients' experiences of nursing care dependence. Journal of Nursing Scholarship, 47(5), 397–406.
Praveen, R. (2015). ALS - Rare Diseases India. Retrieved March 17, 2018, from http://www.rarediseasesindia.org/als
ProGas Study Group. (2015). Gastrostomy in patients with amyotrophic lateral sclerosis (ProGas): A prospective cohort study. Lancet Neurology, 14, 702–709.
Rabinstein, A. A. (2016). Noninvasive ventilation for neuromuscular respiratory failure: When to use and when to avoid. Current Opinion in Critical Care, 22(2), 94–99.
Rigi, M., Almarzbuqi, S. J., Morgan, M. L., et al. (2015). Papilledema: Epidemiology, etiology, and clinical management. Eye and Brain, 2015(7), 45–57.
Rosengren, K., Gustafusson, I., & Jarnevi, E. (2015). Every second counts: Women's experience of living with ALS in the end-of life situations. Home Health Care Management & Practice, 27(2), 76–82.
Ross, C. A., Aylward, E. H., Wild, E. J., et al. (2014). Huntington's disease: National history, biomarkers and prospects for therapeutics. Nature Reviews Neurology, 10, 204–216.
Sarkar, C., Sharma, M. C., Deb, P., Singh, R., Santosh, V., & Shankar, S. K. (2005). Primary central nervous system lymphoma-A hospital based study of incidence and clinicopathological features from India (1983-2003). Journal of Neuro-Oncology, 71(2), 199–204.
*Shin, J. Y., & Habermann, B. (2016a). Medication adherence in people with Parkinson disease. Journal of Neuroscience Nursing, 48(4), 185–204.
*Shin, J. Y., & Habermann, B. (2016b). Nursing research in Parkinson's disease from 2006–2015: A systematic review. Clinical Nursing Research, (2016), 1–15.
Smith, S., D'Cruz, G., Gray, R., et al. (2015). A concept map of what helps people with HD live with their condition. Journal of Huntington's Disease,4(3), 261–270.
Tobin, M. K., Geraghty, J. R., Engelhard, H. H., et al. (2015). Intramedullary spinal cord tumors: A review of current and future treatment strategies. Neurosurgical Focus, 39(2), 1–14.
Vecht, C. J., Kerkhof, M., & Duran-Pena, A. (2014). Seizure prognosis in brain tumors: New insights and evidence-based management. The Oncologist, 19(7), 751–759.
Wilson, E. Pollock, K., & Aubeeluck, A. (2014). Providing care services to people affected by Huntington's disease an overview of the challenges. British Journal of Neuroscience Nursing, 10(3), 139–143.
Who Gets Parkinson's Disease? – Patient Doctor Ring. (n.d.). Retrieved March 17, 2018, from http://pdring.com/who-gets-parkinsons-disease.htm
Woodward, S. (2014). Shining the spotlight on post-polio syndrome. British Journal of Neuroscience Nursing, 10(1), 5.
Xu, M., & Wu, Z.-Y. (2015). Huntington disease in Asia. Chinese Medical Journal, *128*(13), 1815.
Yeole, B. B. (2008). Trends in the brain cancer incidence in India. Asian Pacific Journal of Cancer Prevention, 9, 267-270.

Resources

ALS Association, www.alsa.org
American Brain Tumor Association (ABTA), www.abta.org
American Cancer Society, www.cancer.org
American Association of Neurological Surgeons, www.AANS.org
American Parkinson Disease Association (APDA), www.apdaparkinson.org
Cancer Treatment Centers of America (CTCA), www.cancercenter.org
Michael J. Fox Foundation for Parkinson's Research, www.michaeljfox.org
National Brain Tumor Society, www.braintumor.org
Neurological Society of India (NSI), http://www.neurosocietyindia.com/
Neurological Surgeons Society of India (NSSI), http://www.nssi.in/
Parkinson's Disease Foundation (PDF), www.pdf.org

UNIT

XVII Immunologic Function

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CHAPTER

Assessment of Immune Function

54

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe the body's general immune responses.
2. Discuss the stages of the immune response.
3. Differentiate between cellular and humoral immune responses.
4. Specify the effects of selected variables on function of the immune system.
5. Use assessment parameters for determining the status of patients' immune function.

GLOSSARY

agglutination: clumping effect occurring when an antibody acts as a cross-link between two antigens
antibody: a protein substance developed by the body in response to and interacting with a specific antigen
antigen: substance that induces the production of antibodies
antigenic determinant: the specific area of an antigen that binds with an antibody combining site and determines the specificity of the antigen–antibody reaction
apoptosis: programmed cell death that results from the digestion of deoxyribonucleic acid by end nucleases
B cells: cells that are important for producing a humoral immune response
cellular immune response: the immune system's third line of defense, involving the attack of pathogens by T cells
complement: series of enzymatic proteins in the serum that, when activated, destroy bacteria and other cells
cytokines: generic term for nonantibody proteins that act as intercellular mediators, as in the generation of immune response
cytotoxic T cells: lymphocytes that lyse cells infected with virus; also play a role in graft rejection
epitope: any component of an antigen molecule that functions as an antigenetic determinant by permitting the attachment of certain antibodies
genetic engineering: emerging technology designed to enable replacement of missing or defective genes
helper T cells: lymphocytes that attack foreign invaders (antigens) directly
humoral immune response: the immune system's second line of defense; often termed the *antibody response*
immune response: the coordinated response of the components of the immune system to a foreign agent or organism
immune system: the collection of organs, cells, tissues, and molecules that mediate the immune response
immunity: the body's specific protective response to a foreign agent or organism; resistance to disease, specifically infectious diseases
immunopathology: study of diseases resulting in dysfunctions within the immune system
immunoregulation: complex system of checks and balances that regulates or controls immune responses
immunosenescence: the gradual deterioration of the immune system brought on by the aging process
interferons: proteins formed when cells are exposed to viral or foreign agents; capable of activating other components of the immune system
lymphokines: substances released by sensitized lymphocytes when they come in contact with specific antigens
memory cells: cells that are responsible for recognizing antigens from previous exposure and mounting an immune response
natural killer (NK) cells: lymphocytes that defend against microorganisms and malignant cells
null lymphocytes: lymphocytes that destroy antigens already coated with the antibody
opsonization: the coating of antigen–antibody molecules with a sticky substance to facilitate phagocytosis
phagocytic cells: cells that engulf, ingest, and destroy foreign bodies or toxins
phagocytic immune response: the immune system's first line of defense, involving white blood cells that have the ability to ingest foreign particles
stem cells: precursors of all blood cells; reside primarily in bone marrow
suppressor T cells: lymphocytes that decrease B-cell activity to a level at which the immune system is compatible with life
T cells: cells that are important for producing a cellular immune response

Introduction

Immunity is the body's specific protective response to a foreign agent or organism. The immune system functions as the body's defense mechanism against invasion and allows a rapid response to foreign substances in a specific manner. Genetic and cellular responses result. Any qualitative or quantitative change in the components of the immune system can produce profound effects on the integrity of the human organism. Immune function is affected by a variety of factors, such as central nervous system integrity; general physical and emotional status; medications; dietary patterns; and the stress of illness, trauma, or surgery. Dysfunctions involving the immune system occur across the lifespan. Many are genetically based; others are acquired. Immune memory is a property of the immune system that provides protection against harmful microbial agents despite the timing of re-exposure to the agent. Tolerance is the mechanism by which the immune system is programmed to eliminate foreign substances such as microbes, toxins, and cellular mutations but maintains the ability to accept self-antigens. Some credence is given to the concept of surveillance, in which the immune system is in a perpetual state of vigilance, screening and rejecting any invader that is

TABLE 54-1 Immune System Disorders

Disorder	Description
Autoimmunity	Normal protective immune response paradoxically turns against or attacks the body, leading to tissue damage
Hypersensitivity	Body produces inappropriate or exaggerated responses to specific antigens
Gammopathies	Overproduction of immunoglobulins
Immune deficiencies	
Primary	Deficiency results from improper development of immune cells or tissues; usually congenital or inherited
Secondary	Deficiency results from some interference with an already developed immune system; usually acquired later in life

recognized as foreign to the host. The term immunopathology refers to the study of diseases that result from dysfunctions within the immune system. Disorders of the immune system may stem from excesses or deficiencies of immunocompetent cells, alterations in the function of these cells, immunologic attack on self-antigens, or inappropriate or exaggerated responses to specific antigens (see Table 54-1).

Growing numbers of patients with primary immune deficiencies live to adulthood, and many others acquire immune disorders during their adult years. Thus, nurses in many practice settings need to understand how the immune system functions as well as immunopathologic processes. In addition, knowledge about assessment and care of people with immunologic disorders enables nurses to make appropriate management decisions.

Anatomic and Physiologic Overview

Anatomy of the Immune System

The immune system is composed of an integrated collection of various cell types, each with a designated function in defending against infection and invasion by other organisms. Supporting this system are molecules that are responsible for the interactions, modulations, and regulation of the system. These molecules and cells participate in specific interactions with immunogenic **epitopes** (antigenic determinants) present on foreign materials, initiating a series of actions in a host, including the inflammatory response, the lysis of microbial agents, and the disposal of foreign toxins. The major components of the immune system include central and peripheral organs, tissues, and cells (see Fig. 54-1).

Bone Marrow

The white blood cells (WBCs) involved in immunity are produced in the bone marrow (see Fig. 54-2). Like other blood cells, lymphocytes are generated from stem cells (undifferentiated cells). There are two types of lymphocytes—B lymphocytes (B cells) and T lymphocytes (T cells) (see Fig. 54-3).

Lymphoid Tissues

The spleen, composed of red and white pulp, acts somewhat like a filter. The red pulp is the site where old and injured red blood cells (RBCs) are destroyed. The white pulp contains concentrations of lymphocytes. The lymph nodes, which are

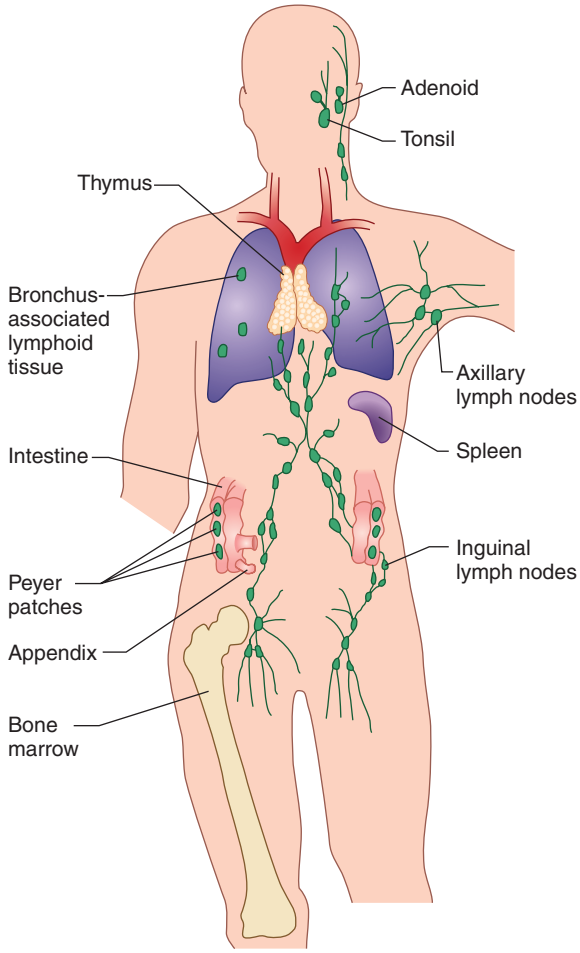


Figure 54-1 • Central and peripheral lymphoid organs, tissues, and cells. Reprinted with permission from Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Physiology/Pathophysiology

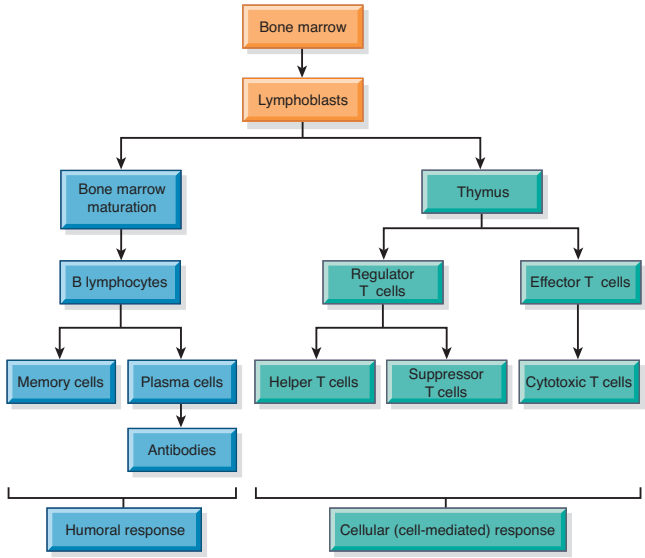


Figure 54-2 • Development of cells of the immune system.

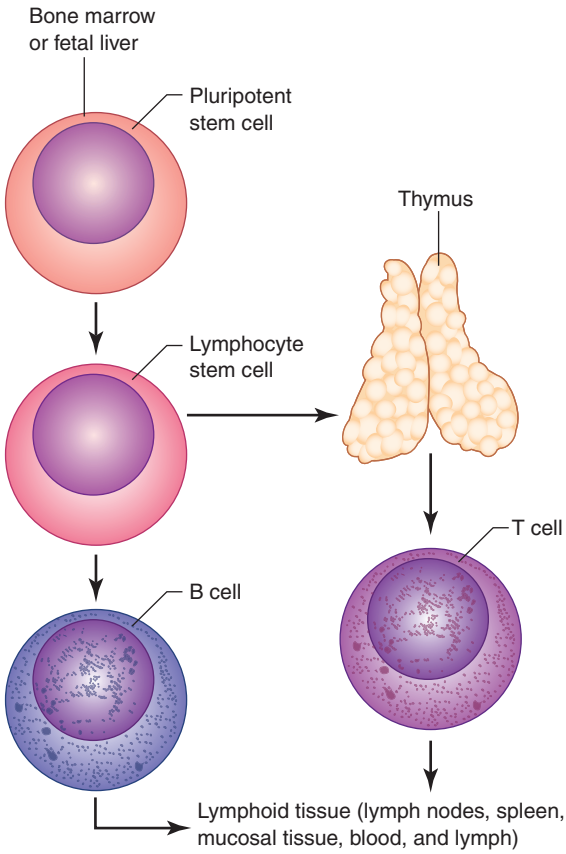


Figure 54-3 • Lymphocytes originate from stem cells in the bone marrow. B lymphocytes mature in the bone marrow before entering the bloodstream, whereas T lymphocytes mature in the thymus, where they also differentiate into cells with various functions. Reprinted with permission from Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

connected by lymph channels and capillaries, are distributed throughout the body. They remove foreign material from the lymph system before it enters the bloodstream. The lymph nodes also serve as centers for immune cell proliferation. The remaining lymphoid tissues contain immune cells that defend the body's mucosal surfaces against microorganisms (McComb, Thiriot, Krishnan, et al., 2013).

Function of the Immune System

The basic function of the immune system is to remove foreign antigens such as viruses and bacteria to maintain homeostasis. There are two general types of immunity: natural (innate) and acquired (adaptive). Natural immunity or nonspecific immunity is present at birth. Acquired or specific immunity develops after birth. Each type of immunity has a distinct role in defending the body against harmful invaders, but the various components are usually interdependent (Levinson, 2014).

Natural Immunity

Natural immunity, which is nonspecific, provides a broad spectrum of defense against and resistance to infection. It is considered the first line of host defense following antigen exposure, because it protects the host without remembering prior contact with an infectious agent (Levinson, 2014). Responses to a foreign invader are very similar from one encounter to the next, regardless of the number of times the invader is encountered. Natural (innate) immunity co-coordinates the initial response to pathogens through the production of cytokines and other effector molecules, which either activate cells for control of the pathogen (by elimination) or promote the development of the acquired immune response. The cells involved in this response are monocytes, macrophages, dendritic cells, natural killer (NK) cells, basophils, eosinophils, and granulocytes. The early events in this process are critical in determining the nature of the adaptive immune response. Natural immune mechanisms can be divided into two stages: immediate (generally occurring within minutes) and delayed (occurring within several days after exposure) (Levinson, 2014).

White Blood Cell Action

The cellular response is the key to the effective initiation of the immune response. WBCs, or leukocytes, participate in both the natural and the acquired immune responses. Granular leukocytes, or granulocytes (so called because of granules in their cytoplasm), fight invasion by foreign bodies or toxins by releasing cell mediators, such as histamine, bradykinin, and prostaglandins, and by engulfing the foreign bodies or toxins. Granulocytes include neutrophils, eosinophils, and basophils.

Neutrophils (polymorphonuclear leukocytes) are the first cells to arrive at the site where inflammation occurs. Eosinophils and basophils, other types of granulocytes, increase in number during allergic reactions and stress responses. Nongranular leukocytes include monocytes or macrophages (referred to as histiocytes when they enter tissue spaces) and lymphocytes. Monocytes are the first to arrive on the scene and function as phagocytic cells, engulfing, ingesting, and destroying greater numbers and quantities of foreign bodies or toxins than granulocytes do. Lymphocytes, consisting of B cells and T cells, play major roles in humoral and cell-mediated immune responses. About 70% to 80% of lymphocytes in the blood are T cells, and about 10% to 15% are B cells (Haynes, Soderberg, & Fauci, 2015).

Inflammatory Response

The inflammatory response is a major function of the natural immune system that is elicited in response to tissue injury or invading organisms. Chemical mediators assist this response by minimizing blood loss, walling off the invading organism, activating phagocytes, and promoting formation of fibrous scar tissue and regeneration of injured tissue. The inflammatory response is facilitated by physical and chemical barriers that are part of the human organism.

Physical and Chemical Barriers

Activation of the natural immunity response is enhanced by processes inherent in physical and chemical barriers. Physical surface barriers include intact skin, mucous membranes, and cilia of the respiratory tract, which prevent pathogens from gaining access to the body. The cilia of the respiratory tract, along with coughing and sneezing responses, filter and clear pathogens from the upper respiratory tract before they can invade the body further. Chemical barriers, such as mucus, acidic gastric secretions, enzymes in tears and saliva, and substances in sebaceous and sweat secretions, act in a nonspecific way to destroy invading bacteria and fungi. Viruses are countered by other means, such as interferon (see discussion later in chapter).

Immune Regulation

Regulation of the immune response involves balance and counterbalance. Dysfunction of the natural immune system can occur when the immune components are inactivated or when they remain active long after their effects are beneficial. A successful immune response eliminates the responsible antigen. If an immune response fails to develop and clear an antigen sufficiently, the host is considered to be immunocompromised or immunodeficient. If the response is overly robust or misdirected, allergies, asthma, or autoimmune disease results. The immune system's recognition of one's own cells or tissues as "foreign" rather than as self is the basis of many autoimmune disorders (Grossman & Porth, 2014). Despite the fact that the immune response is critical to the prevention of disease, it must be well controlled to curtail immunopathology. Most microbial infections induce an inflammatory response mediated by T cells and cytokines, which, in excess, can cause tissue damage (Haynes et al., 2015). Therefore, regulatory mechanisms must be in place to suppress or halt the immune response. This is mainly achieved by the production of cytokines and transformation of growth factor that inhibit macrophage activation. In some cases, T-cell activation is so acute that these mechanisms fail, and pathology develops. Ongoing research on immunoregulation holds the promise of preventing graft rejection and aiding the body in eliminating cancerous or infected cells (Kannan, Madden, & Andrews, 2013); (Lo, Lee, & Powell, 2014).

Although natural immunity can often effectively combat infections, many pathogenic microbes have evolved that resist natural immunity. Acquired immunity is necessary to defend against these resistant agents.

Acquired Immunity

Acquired (adaptive) immunity usually develops as a result of prior exposure to an antigen through immunization (vaccination) or by contracting a disease, both of which generate a protective immune response. Weeks or months after exposure to the disease or vaccine, the body produces an immune response that is sufficient to defend against the disease on re-exposure. In contrast to the rapid but nonspecific natural immune response, this form of immunity relies on the recognition of specific foreign antigens. The acquired immune response is broadly divided into two mechanisms: (1) the cell-mediated response, involving T-cell activation, and (2) effector mechanisms, involving B-cell maturation and production of antibodies (Haynes et al., 2015).

The two types of acquired immunity are known as active and passive and are interrelated. Active acquired immunity refers to immunologic defenses developed by the person's own body. This immunity typically lasts many years or even a lifetime. Passive acquired immunity is temporary immunity transmitted from a source outside the body that has developed immunity through previous disease or immunization. Examples include immunity resulting from the transfer of antibodies from the mother to an infant in utero or through breast-feeding or receiving injections of immune globulin. Active and passive acquired immunity involve humoral and cellular (cell-mediated) immunologic responses (described later).

Response to Invasion

When the body is invaded or attacked by bacteria, viruses, or other pathogens, it has three means of defense:

- The phagocytic immune response
- The humoral or antibody immune response
- The cellular immune response

The first line of defense, the phagocytic immune response, primarily involves the WBCs (granulocytes and macrophages), which have the ability to ingest foreign particles and destroy the invading agent; eosinophils are only weakly phagocytic. Phagocytes also remove the body's own dying or dead cells. Cells in necrotic tissue that are dying release substances that trigger an inflammatory response. Apoptosis, or programmed cell death, is the body's way of destroying worn-out cells such as blood or skin cells or cells that need to be renewed (Grossman & Porth, 2014).

A second protective response, the humoral immune response (sometimes called the ***antibody response***), begins with the B lymphocytes, which can transform themselves into plasma cells that manufacture antibodies. These antibodies are highly specific proteins that are transported in the bloodstream and attempt to disable invaders. The third mechanism of defense, the cellular immune response, also involves the T lymphocytes, which can turn into special cytotoxic (or killer) T cells that can attack the pathogens.

The structural part of the invading or attacking organism that is responsible for stimulating antibody production is called an antigen (or an immunogen). For example, an antigen can be a small patch of proteins on the outer surface of a microorganism. Not all antigens are naturally immunogenic; some must be coupled to other molecules to stimulate the immune response. A single bacterium or large molecule, such as a diphtheria or tetanus toxin, may have several antigens, or markers, on its surface, thus inducing the body to produce a number of different antibodies. Once produced, an antibody is released into the bloodstream and carried to the attacking organism. There, it combines with the antigen, binding with it like an interlocking piece of a jigsaw puzzle (see Fig. 54-4). There are

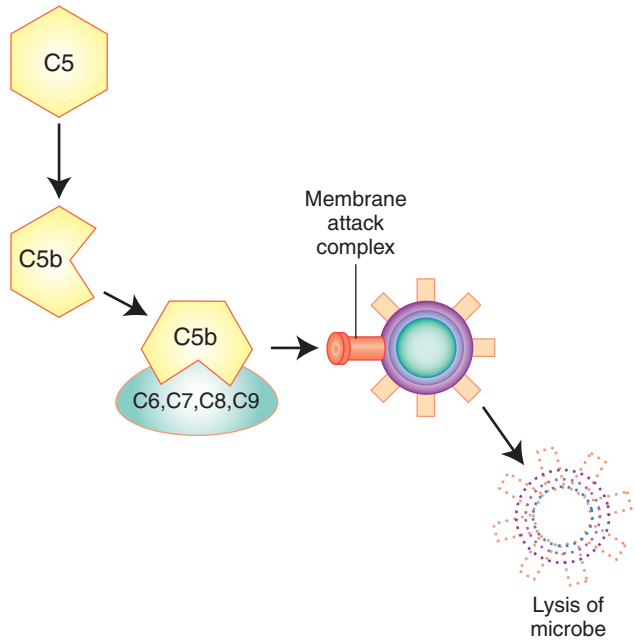


Figure 54-4 • Complement-mediated immune responses. Reprinted with permission from Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

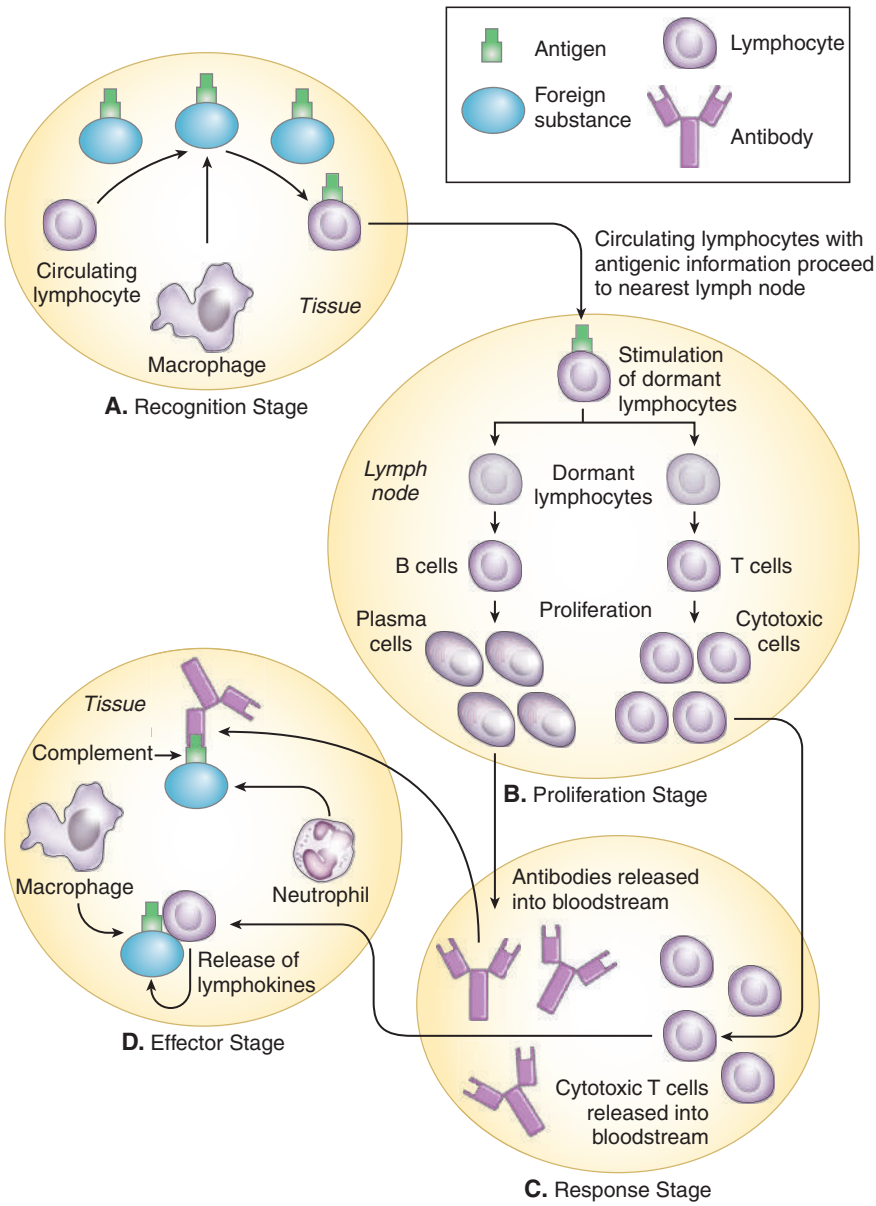


Figure 54-5 • Stages of the immune response. **A.** In the *recognition stage,* antigens are recognized by circulating lymphocytes and macrophages. **B.** In the *proliferation stage,* the dormant lymphocytes proliferate and differentiate into cytotoxic (killer) T cells or B cells responsible for formation and release of antibodies. **C.** In the *response stage,* the cytotoxic T cells and the B cells perform cellular and humoral functions, respectively. **D.** In the *effector stage,* antigens are destroyed or neutralized through the action of antibodies, complement, macrophages, and cytotoxic T cells.

four well-defined stages in an immune response: recognition, proliferation, response, and effector (see Fig. 54-5).

Recognition Stage

Recognition of antigens as foreign, or non-self, by the immune system is the initiating event in any immune response. Recognition involves the use of lymph nodes and lymphocytes for surveillance. Lymph nodes are widely distributed internally throughout the body and in the circulating blood, as well as externally near the body's surfaces. They continuously discharge small lymphocytes into the bloodstream. These lymphocytes patrol the tissues and vessels that drain the areas served by that node. Lymphocytes recirculate from the blood to lymph nodes and from the lymph nodes back into the bloodstream in a continuous circuit. Lymphocytes and other cells have "microbial sensors" that identify molecules on microbes and other microorganisms. The interaction of these sensors with the offending agent sets off a cascade aimed at destroying the microbe (Paul, 2013). Invading organisms have pathogen-associated molecular patterns (PAMPs) contained in their cell membranes that are recognized by the immune system cells. Once the receptors on the immune cells come into contact with the PAMPs, the immune response is triggered (Grossman & Porth, 2014). Macrophages play an important role in helping the circulating lymphocytes process the antigens. Both macrophages and neutrophils have receptors for antibodies and complement; as a result, they coat microorganisms with antibodies, complement, or both, thereby enhancing phagocytosis.

In a streptococcal throat infection, for example, the streptococcal organism gains access to the mucous membranes of the throat. A circulating lymphocyte moving through the tissues of the throat comes in contact with the organism.

The lymphocyte recognizes the antigens on the microbe as different (non-self) and the streptococcal organism as antigenic (foreign). This triggers the second stage of the immune response—proliferation.

Proliferation Stage

The circulating lymphocytes containing the antigenic message return to the nearest lymph node. Once in the node, these sensitized lymphocytes stimulate some of the resident T and B lymphocytes to enlarge, divide, and proliferate. T lymphocytes differentiate into cytotoxic (or killer) T cells, whereas B lymphocytes produce and release antibodies. Enlargement of the lymph nodes in the neck in conjunction with a sore throat is one example of the immune response.

Response Stage

In the response stage, the differentiated lymphocytes function in either a humoral or a cellular capacity. This stage begins with the production of antibodies by the B lymphocytes in response to a specific antigen. The cellular response stimulates the resident lymphocytes to become cells that attack microbes directly rather than through the action of antibodies. These transformed lymphocytes are known as cytotoxic (killer) T cells.

Viral rather than bacterial antigens induce a cellular response. This response is manifested by the increasing number of T lymphocytes (lymphocytosis) seen in the blood tests of people with viral illnesses such as infectious mononucleosis. (Cellular immunity is discussed in further detail later in this chapter.) Most immune responses to antigens involve both humoral and cellular responses, although one usually predominates. For example, during transplant rejection, the cellular response involving T cells predominates, whereas in the bacterial pneumonias and sepsis, the humoral response involving B cells plays the dominant protective role (see Chart 54-1).

Effector Stage

In the effector stage, either the antibody of the humoral response or the cytotoxic (killer) T cell of the cellular response reaches and connects with the antigen on the surface of the foreign invader. This initiates activities involving interplay of antibodies (humoral immunity), complement, and action by the cytotoxic T cells (cellular immunity).

Chart 54-1

Comparison of Cellular and Humoral Immune Responses

Humoral Responses (B Cells)

- Bacterial phagocytosis and lysis
- Anaphylaxis
- Allergic hay fever and asthma
- Immune complex disease
- Bacterial and some viral infections

Cellular Responses (T Cells)

- Transplant rejection
- Delayed hypersensitivity (tuberculin reaction)
- Graft-versus-host disease
- Tumor surveillance or destruction
- Intracellular infections
- Viral, fungal, and parasitic infections

Humoral Immune Response

The humoral response is characterized by the production of antibodies by B lymphocytes in response to a specific antigen. Whereas B lymphocytes are responsible for the production of antibodies, both the macrophages of natural immunity and the special T lymphocytes of cellular immunity are involved in recognition.

Antigen Recognition

Several theories explain the mechanisms by which B lymphocytes recognize the invading antigen and respond by producing antibodies. It is known that B lymphocytes recognize and respond to invading antigens in more than one way.

The B lymphocytes respond to some antigens by directly triggering antibody formation; however, in response to other antigens, they need the assistance of T cells to trigger antibody formation. With the help of macrophages, the T lymphocytes are believed to recognize the antigen of a foreign invader. The T lymphocyte picks up the antigenic message, or "blueprint," of the antigen and returns to the nearest lymph node with that message. B lymphocytes stored in the lymph nodes are subdivided into thousands of clones, which are stimulated to enlarge, divide, proliferate, and differentiate into plasma cells capable of producing specific antibodies to the antigen. Other B lymphocytes differentiate into B-lymphocyte clones with a memory for the antigen. These memory cells are responsible for the more exaggerated and rapid immune response in a person who is repeatedly exposed to the same antigen.

Role of Antibodies

Antibodies are large proteins, called *immunoglobulins,* that consist of two subunits, each containing a light and a heavy peptide chain held together by a chemical link composed of disulfide bonds. Each subunit has one portion that serves as a binding site for a specific antigen and another portion that allows the antibody molecule to take part in the complement system.

Antibodies defend against foreign invaders in several ways, and the type of defense used depends on the structure and composition of both the antigen and the immunoglobulin. The antibody molecule has at least two combining sites, or Fab fragments (see Fig. 54-6). One antibody can act as a cross-link between two antigens, causing them to bind or clump together. This clumping effect, referred to as agglutination, helps clear the body of the invading organism by facilitating phagocytosis. Some antibodies assist in the removal of offending organisms through opsonization. In this process, the antigen–antibody molecule is coated with a sticky substance that also facilitates phagocytosis.

Antibodies also promote the release of vasoactive substances, such as histamine and slow-reacting substances, two of the chemical mediators of the inflammatory response. Antibodies do not function in isolation; rather, they mobilize other components of the immune system to defend against the invader.

The body can produce five different types of immunoglobulin (Ig). Each of the five types, or classes, is identified by a specific letter of the alphabet, IgA, IgD, IgE, IgG, and IgM. Classification is based on the chemical structure and biologic role of the individual immunoglobulin. Major characteristics of the immunoglobulins are summarized in Chart 54-2. The normal laboratory values for the three major Igs (IgA, IgG, and IgM) can be found in Table 57-1 in Chapter 57;

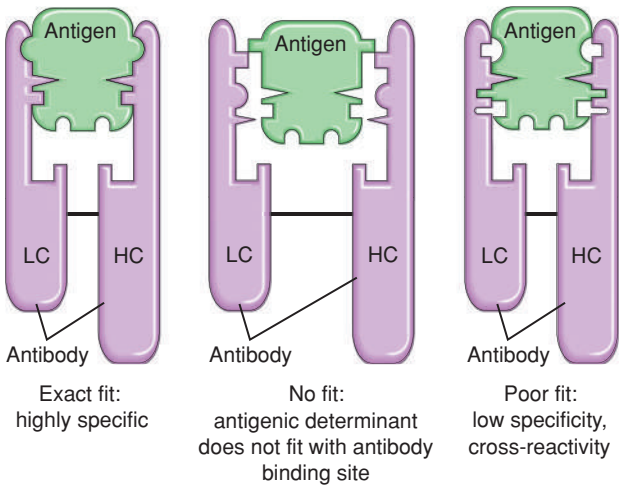


Figure 54-6 • Antigen–antibody binding. (***Left***) A highly specific antigen–antibody complex. (***Center***) No match and, therefore, no immune response. (***Right***) Poor fit or match with low specificity; antibody reacts to antigen with similar characteristics, producing cross-reactivity. HC, heavy chain; LC, light chain.

Chart 54-2

Major Characteristics of the Immunoglobulins

IgG (75% of Total Immunoglobulin)

- Appears in serum and tissues (interstitial fluid)
- Assumes a major role in blood-borne and tissue infections
- Activates the complement system
- Enhances phagocytosis
- Crosses the placenta

IgA (15% of Total Immunoglobulin)

- Appears in body fluids (blood, saliva, tears, and breast milk, as well as pulmonary, gastrointestinal, prostatic, and vaginal secretions)
- Protects against respiratory, gastrointestinal, and genitourinary infections
- Prevents absorption of antigens from food
- Passes to neonate in breast milk for protection

IgM (10% of Total Immunoglobulin)

- Appears mostly in intravascular serum
- Appears as the first immunoglobulin produced in response to bacterial and viral infections
- Activates the complement system

IgD (0.2% of Total Immunoglobulin)

- Appears in small amounts in serum
- Possibly influences B-lymphocyte differentiation, but role is unclear

IgE (0.004% of Total Immunoglobulin)

- Appears in serum
- Takes part in allergic and some hypersensitivity reactions
- Combats parasitic infections

Ig immunoglobulin.

Adapted from Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed., p. 278). Philadelphia, PA: Lippincott Williams & Wilkins.

Antigen–Antibody Binding

The portion of the antigen involved in binding with the antibody is referred to as the antigenic determinant. The most efficient immunologic responses occur when the antibody and antigen fit like a lock and key. Poor fit can occur with an antibody that was produced in response to a different antigen. This phenomenon is known as cross-reactivity. For example, in acute rheumatic fever, the antibody produced against *Streptococcus pyogenes* in the upper respiratory tract may cross-react with the patient's heart tissue, leading to heart valve damage.

Cellular Immune Response

The T lymphocytes are primarily responsible for cellular immunity. Stem cells continuously migrate from the bone marrow to the thymus gland, where they develop into T cells. Despite the partial degeneration of the gland at puberty, T cells continue to develop in the thymus gland. Several types of T cells exist, each with designated roles in the defense against bacteria, viruses, fungi, parasites, and malignant cells. T cells attack foreign invaders directly rather than by producing antibodies.

Cellular reactions are initiated, with or without the assistance of macrophages, by the binding of an antigen to an antigen receptor located on the surface of a T cell. The T cells then carry the antigenic message, or blueprint, to the lymph nodes, where the production of other T cells is stimulated. Some T cells remain in the lymph nodes and retain a memory for the antigen. Other T cells migrate from the lymph nodes into the general circulatory system and ultimately to the tissues, where they remain until they either come in contact with their respective antigens or die (Grossman & Porth, 2014).

Types of T Lymphocytes

T cells include effector T cells, suppressor T cells, and memory T cells. The two major categories of effector T cells—helper T cells (also referred to as $CD4^+$ cells) and cytotoxic T cells (also referred to as $CD8^+$ cells)—participate in the destruction of foreign organisms. T cells interact closely with B cells, indicating that humoral and cellular immune responses are not separate, unrelated processes but rather are branches of the immune response that interact.

Helper T cells are activated on recognition of antigens and stimulate the rest of the immune system. When activated, helper T cells secrete cytokines, which attract and activate B cells, cytotoxic T cells, NK cells, macrophages, and other cells of the immune system. Cytokines are proteins produced by the cells of the immune system that determine the actions of the immune system cells. Separate subpopulations of helper T cells produce different types of cytokines and determine whether the immune response will be the production of antibodies or a cell-mediated immune response. Helper T cells also produce lymphokines, one category of cytokines (see Table 54-2).

Cytotoxic T cells (killer T cells) attack the antigen directly by altering the cell membrane, causing cell lysis (disintegration), and releasing cytolytic enzymes and cytokines. Lymphokines can recruit, activate, and regulate other lymphocytes and WBCs. These cells then assist in destroying the invading organism. Delayed-type hypersensitivity is an example of an immune reaction that protects the body from antigens through the production and release of lymphokines (see later discussion).

Suppressor T cells have the ability to decrease B-cell production, thereby keeping the immune response at a level

TABLE 54-2 Cytokines of Innate and Adaptive Immunity

Cytokines	Source	Biologic Activity
Interleukin 1 (IL-1)	Macrophages, endothelial cells, some epithelial cells	Wide variety of biologic effects; activates endothelium in inflammation; induces fever and acute-phase response; stimulates neutrophil production
Interleukin 2 (IL-2)	$CD4^+$, $CD8^+$ T cells	Growth factor for activated T cells; induces synthesis of other cytokines; activates cytotoxic T lymphocytes and NK cells
Interleukin 3 (IL-3)	$CD4^+$ T cells	Growth factor for progenitor hematopoietic cells
Interleukin 4 (IL-4)	$CD4^+$ T_H2 cells, mast cells	Promotes growth and survival of T, B, and mast cells; causes T_H2 cell differentiation; activates B cells and eosinophils and induces IgE-type responses
Interleukin 5 (IL-5)	$CD4^+$ T_H2 cells	Induces eosinophil growth and development
Interleukin 6 (IL-6)	Macrophages, endothelial cells, T lymphocytes	Stimulates the liver to produce mediators of acute-phase inflammatory response; also induces proliferation of antibody-producing cells by the adaptive immune system
Interleukin 7 (IL-7)	Bone marrow stromal cells	Primary function in adaptive immunity; stimulates pre-B cells and thymocyte development and proliferation
Interleukin 8 (IL-8)	Macrophages, endothelial cells	Primary function in adaptive immunity; chemoattracts neutrophils and T lymphocytes; regulates lymphocyte homing and neutrophil infiltration
Interleukin 10 (IL-10)	Macrophages, some T-helper cells	Inhibitor of activated macrophages and dendritic cells; decreases inflammation by inhibiting T_H1 cells and release of interleukin 12 from macrophages
Interleukin 12 (IL-12)	Macrophages, dendritic cells	Enhances NK cell cytotoxicity in innate immunity; induces T_H1 cell differentiation in adaptive immunity
Type I interferons (IFN-α, IFN-β)	Macrophages, fibroblasts	Inhibit viral replication, activate NK cells, and increase expression of MHC-I molecules on virus-infected cells
Interferon-γ (IFN-γ)	NK cells, $CD4^+$ and $CD8^+$ T lymphocytes	Activates macrophages in both innate immune responses and adaptive cell-mediated immune responses; increases expression of MHC I and II and antigen processing and presentation
Tumor necrosis factor-α (TNF-α)	Macrophages, T cells	Induces inflammation, fever, and acute-phase response; activates neutrophils and endothelial cells; kills cells through apoptosis
Chemokines	Macrophages, endothelial cells, T lymphocytes	Large family of structurally similar cytokines that stimulate leukocyte movement and regulate the migration of leukocytes from the blood to the tissues
Granulocyte-monocyte CSF (GM-CSF)	T cells, macrophages, endothelial cells, fibroblasts	Promotes neutrophil, eosinophil, and monocyte maturation and growth; activates mature granulocytes
Granulocyte CSF (G-CSF)	Macrophages, fibroblasts, endothelial cells	Promotes growth and maturation of neutrophils consumed in inflammatory reactions
Monocyte CSF (M-CSF)	Macrophages, activated T cells, endothelial cells	Promotes growth and maturation of mononuclear phagocytes

CSF, colony-stimulating factor; MHC, major histocompatibility complex; NK, natural killer; IgE, immunoglobulin E; T_H1, T-helper type 1; T_H2, T-helper type 2.
Adapted from Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

that is compatible with health (e.g., sufficient to fight infection adequately without attacking the body's healthy tissues). Memory cells are responsible for recognizing antigens from previous exposure and mounting an immune response (see Table 54-3).

Null Lymphocytes and Natural Killer Cells

Null lymphocytes and NK cells are other lymphocytes that assist in combating organisms. These cells are distinct from B cells and T cells and lack the usual characteristics of those cells. Null lymphocytes, a subpopulation of lymphocytes, destroy antigens already coated with antibody. These cells have special receptor sites on their surface that allow them to connect with the end of antibodies; this is known as antibody-dependent, cell-mediated cytotoxicity.

NK cells are a class of lymphocytes that recognize infected and stressed cells and respond by killing these cells and by secreting macrophage-activating cytokine. The helper T cells contribute to the differentiation of null and NK cells.

Complement System

Circulating plasma proteins, known as complement, are made in the liver and activated when an antibody connects with its antigen. Complement plays an important role in the defense against microbes. Destruction of an invading or attacking organism or toxin is not achieved merely by the binding of the antibody and antigens; it also requires activation of complement, the arrival of killer T cells, or the attraction of macrophages. Complement has three major physiologic functions: defending the body against bacterial infection, bridging natural and acquired

TABLE 54-3 Lymphocytes Involved in Immune Responses

Type of Immune Response	Cell Type	Function
Humoral	B lymphocyte	Produces antibodies or immunoglobulins (IgA, IgD, IgE, IgG, IgM)
Cellular	T lymphocyte	
	Helper T	Attacks foreign invaders (antigens) directly Initiates and augments inflammatory response
	Helper T_1	Increases activated cytotoxic T cells
	Helper T_2	Increases B-cell (BG8) antibody production
	Suppressor T	Suppresses the immune response
	Memory T	Remembers contact with an antigen and on subsequent exposures mounts an immune response
	Cytotoxic T (killer T)	Lyses cells infected with virus; plays a role in graft rejection
Nonspecific	Non-T or non-B lymphocyte Null cell	Destroys antigens already coated with antibody
	Natural killer cell (granular lymphocyte)	Defends against microorganisms and some types of malignant cells; produces cytokines

immunity, and disposing of immune complexes and the by-products associated with inflammation (Grossman & Porth, 2014).

The proteins that comprise complement interact sequentially with one another in a cascading effect. The complement cascade is important to modifying the effector arm of the immune system. Activation of complement allows important events, such as removal of infectious agents and initiation of the inflammatory response, to take place. These events involve active parts of the pathway that enhance chemotaxis of macrophages and granulocytes, alter blood vessel permeability, change blood vessel diameters, cause cells to lyse, alter blood clotting, and cause other points of modification. These macrophages and granulocytes continue the body's defense by devouring the antibody-coated microbes and by releasing bacterial products.

The complement cascade may be activated by any of three pathways: classic, lectin, and alternative. The classic pathway is triggered after antibodies bind to microbes or other antigens and is part of the humoral type of adaptive immunity. The lectin pathway is activated when a plasma protein (mannose-binding lectin) binds to terminal mannose residue on the surface glycoproteins of microbes. The alternative pathway is triggered when complement proteins are activated on microbial surfaces. This pathway is part of natural immunity.

Complement components, prostaglandins, leukotrienes, and other inflammatory mediators all contribute to the recruitment of inflammatory cells, as do chemokines, a group of cytokines. The activated neutrophils pass through the vessel walls to accumulate at the site of infection, where they phagocytize complement-coated microbes (Grossman & Porth, 2014). This response is usually therapeutic and can be lifesaving if the cell attacked by the complement system is a true foreign invader. However, if that cell is part of the human organism, the result can be devastating disease and even death. Many autoimmune diseases and disorders characterized by chronic infection are thought to be caused in part by continued or chronic activation of complement, which in turn results in chronic inflammation. The RBCs and platelets have complement receptors and, as a result, play an important role in the clearance of immune complexes that consist of antigen, antibody, and components of the complement system (Grossman & Porth, 2014).

Immunomodulators

Antimicrobial agents and vaccines have yielded considerable therapeutic success and the immune system usually works effectively; however, many infectious diseases remain difficult clinical challenges. Treatment success may be compromised by defects of the immune system; in this case, enhancement of the host immune response may be therapeutically beneficial. An immunomodulator (also known as a biologic response modifier) affects the host via direct or indirect effects on one or more components of the immunoregulatory network. Interferons, colony-stimulating factors, and monoclonal antibodies (MoAbs) are examples of agents used to help enhance the immune system (Page & Liles, 2015).

Interferons

Interferon, one type of biologic response modifier, is a nonspecific viricidal protein that is naturally produced by the body and is capable of activating other components of the immune system. Interferons continue to be investigated to determine their roles in the immune system and their potential therapeutic effects in disorders characterized by disturbed immune responses. These substances have antiviral and antitumor properties. In addition to responding to viral infection, interferons are produced by T lymphocytes, B lymphocytes, and macrophages in response to antigens. They are thought to modify the immune response by suppressing antibody production and cellular immunity. They also facilitate the cytolytic role of macrophages and NK cells. Interferons are used to treat immune-related disorders (e.g., multiple sclerosis) and chronic inflammatory conditions (e.g., chronic hepatitis). Research continues to evaluate the effectiveness of interferons in treating cancers (Booy, Hofland, & van Eijck, 2015) and acquired immunodeficiency syndrome.

Colony-Stimulating Factors

Colony-stimulating factors are a group of naturally occurring glycoprotein cytokines that regulate production, differentiation, survival, and activation of hematopoietic cells. Erythropoietin stimulates RBC production. Thrombopoietin plays a key regulatory role in the growth and differentiation of bone marrow cells. Interleukin 5 (IL-5) stimulates the growth and survival of eosinophils and basophils. Stem cell factor and IL-3 serve as stimuli for multiple hematopoietic cell lines. Granulocyte colony-stimulating factor, granulocyte-macrophage colony-stimulating factor, and macrophage colony-stimulating factor all serve as growth factors for specific cell lines. These cytokines have attracted considerable interest for their potential role in immunomodulation (Page & Liles, 2015).

Monoclonal Antibodies

MoAbs have become available through technologic advances, enabling investigators to grow and produce targeted antibodies for specific pathologic organisms. This type of specificity allows MoAbs to destroy pathologic organisms and spare normal cells. The specificity of MoAbs depends on identifying key antigen proteins that are present on the surface of tumors, but not on normal tissues. When the MoAb attaches to the cell surface antigen, it blocks an important signal transduction pathway for communication between the malignant cells and the extracellular environment. The results may include an inability to initiate apoptosis, reproduce, or invade surrounding tissues. To date, more than 1000 tumor antigens have been identified (Glassman & Balthasar, 2014). See Chapter 58 for a discussion on the use of MoAbs in cancer.

Advances in Immunology

Genetic Engineering

One of the more remarkable evolving technologies is genetic engineering, which uses recombinant deoxyribonucleic acid (DNA) technology. Two facets of this technology exist. The first permits scientists to combine genes from one type of organism with genes of a second organism. This type of technology allows cells and microorganisms to manufacture proteins, monokines, and lymphokines, which can alter and enhance immune system function. The second facet of recombinant DNA technology involves gene therapy. If a particular gene is abnormal or missing, experimental recombinant DNA technology may be capable of restoring normal gene function. For example, a recombinant gene is inserted onto a virus particle. When the virus particle splices its genes, the virus automatically inserts the missing gene and theoretically corrects the genetic anomaly. Extensive research into recombinant DNA technology and gene therapy is ongoing (Geering & Fussenegger, 2015).

Stem Cells

Stem cells are capable of self-renewal and differentiation; they continually replenish the body's entire supply of both RBCs and WBCs. Some stem cells, described as totipotent cells, have tremendous capacity to self-renew and differentiate. Embryonic stem cells, described as pluripotent, give rise to numerous cell types that are able to form tissues. Research has shown that stem cells can restore an immune system that has been destroyed (Kessler, 2015). Stem cell transplantation has been carried out in humans with certain types of immune dysfunction, such as severe combined immunodeficiency; clinical trials using stem cells are under way in patients with a variety of disorders having an autoimmune component, including systemic lupus erythematosus, rheumatoid arthritis, scleroderma, and multiple sclerosis. Research with embryonic stem cells has enabled investigators to make substantial gains in developmental biology, gene therapy, therapeutic tissue engineering, and the treatment of a variety of diseases (Kessler, 2015). However, along with these remarkable opportunities, many ethical challenges arise, which are largely based on concerns about safety, efficacy, resource allocation, and human cloning.

Cancer and Immunotherapy

It has long been understood that the immune system plays a role in fighting off malignancies. Recent advances in cancer treatment have sought to augment the body's natural antitumor activity and to shut down the pathways that allow malignancies to elude the immune system, which has led to the development of such treatments as MoAbs, cancer vaccines, immune adjuvants, immune checkpoint inhibitors, and cytokines (Kannan et al., 2013). These immunotherapeutic treatments are designed to stimulate the patient's immune system to mount its own defense against the cancer and have shown very promising results in a number of different cancer types. See Chapter 58 for a discussion on the use of immunotherapy in cancer.

Assessment of the Immune System

An assessment of immune function begins during the health history and physical examination. Areas to be assessed include nutritional status; infections and immunizations; allergies; disorders and disease states, such as autoimmune disorders, cancer, and chronic illnesses; surgeries; medications; and blood transfusions. In addition to inspection of general characteristics, palpation of the lymph nodes and examinations of the skin, mucous membranes, and respiratory, gastrointestinal, musculoskeletal, genitourinary, cardiovascular, and neurosensory systems are performed (see Chart 54-3).

Health History

The history should note the patient's age along with information about past and present conditions and events that may provide clues to the status of the patient's immune system.

Gender

There are differences in the immune system functions of men and women. For example, many autoimmune diseases have a higher incidence in females than in males, a phenomenon believed to be correlated with sex hormones. Sex hormones have long been recognized for their role in reproductive function; in the past two decades, research has revealed that these hormones are integral signaling modulators of the immune system. Sex hormones play definitive roles in lymphocyte maturation, activation, and synthesis of antibodies and cytokines. In autoimmune disease, expression of sex hormones is altered, and this change contributes to immune dysregulation (Ngo, Steyn, & McCombe, 2014).

Gerontologic Considerations

Immunosenescence is a complex route in which the aging process stimulates changes in the immune system (Shekarabi & Asgari, 2014). Some of the changes that occur in immunosenescence include, but are not limited to, bone marrow defects, dysfunction of the thymus gland, and impaired lymphocytes. Cellular changes occur as the result of aging and include impaired neutrophil function, decreased amount of circulating macrophages, impaired dendritic cell function, and reduced T-cell activation (Müller & Pawelec, 2014). As the immune system undergoes age-associated alterations, its response to infections progressively deteriorates. The capacity for self-renewal of hematopoietic stem cells diminishes. There is a notable decline in the total number of phagocytes, coupled with an intrinsic reduction in their activity. The cytotoxicity of NK cells decreases, contributing to a decline in humoral immunity (Müller & Pawelec, 2014). Acquired immunity may be negatively affected; the efficacy of vaccines is frequently decreased in older

Chart 54-3 ASSESSMENT

Assessing for Immune Dysfunction

Be alert for the following signs and symptoms:

Respiratory System

- Changes in respiratory rate
- Cough (dry or productive)
- Abnormal lung sounds (wheezing, crackles, rhonchi)
- Rhinitis
- Hyperventilation
- Bronchospasm

Cardiovascular System

- Hypotension
- Tachycardia
- Dysrhythmia
- Vasculitis
- Anemia

Gastrointestinal System

- Hepatosplenomegaly
- Colitis
- Vomiting
- Diarrhea

Genitourinary System

- Frequency and burning on urination
- Hematuria
- Discharge

Musculoskeletal System

- Joint mobility, edema, and pain

Skin

- Rashes
- Lesions
- Dermatitis
- Hematomas or purpura
- Edema or urticaria
- Inflammation
- Discharge

Neurosensory System

- Cognitive dysfunction
- Hearing loss
- Visual changes
- Headaches and migraines
- Ataxia
- Tetany

adults (Goronzy & Weyand, 2013). Inflammatory cytokines tend to increase with age.

Older adults have increased the incidence of infections, autoimmune diseases, metabolic diseases, osteoporosis, and neurologic disorders (Müller & Pawelec, 2014).The increased incidence of autoimmune diseases may be from a decreased ability of antibodies to differentiate between self and non-self. Failure of the surveillance system to recognize mutant or abnormal cells also may be responsible, in part, for the high incidence of cancer associated with increasing age.

Age-related changes in many body systems also contribute to impaired immunity (see Table 54-4). For example,

TABLE 54-4 Age-Related Changes in Immunologic Function

Body System	Changes	Consequences
Immune	Impaired function of B and T lymphocytes Failure of lymphocytes to recognize mutant or abnormal cells Decreased antibody production Failure of immune system to differentiate "self" from "non-self" Suppressed phagocytic immune response	Suppressed responses to pathogenic organisms with increased risk for infection Increased incidence of cancers Anergy (lack of response to antigens applied to the skin [allergens]) Increased incidence of autoimmune diseases Absence of typical signs and symptoms of infection and inflammation Dissemination of organisms usually destroyed or suppressed by phagocytes (e.g., reactivation or spread of tuberculosis)
Gastrointestinal	Decreased gastric secretions and motility Decreased phagocytosis by the liver's Kupffer cells Altered nutritional intake with inadequate protein intake	Proliferation of intestinal organisms resulting in gastroenteritis and diarrhea Increased incidence and severity of hepatitis B; increased incidence of liver abscesses Suppressed immune response
Urinary	Decreased kidney function and changes in lower urinary tract function (enlargement of prostate gland, neurogenic bladder); altered genitourinary tract flora	Urinary stasis and increased incidence of urinary tract infections
Pulmonary	Impaired ciliary action due to exposure to smoke and environmental toxins	Impaired clearance of pulmonary secretions; increased incidence of respiratory infections
Integumentary	Thinning of skin with less elasticity; loss of adipose tissue	Increased risk of skin injury, breakdown, and infection
Circulatory	Impaired microcirculation	Stasis and pressure ulcers
Neurologic function	Decreased sensation and slowing of reflexes	Increased risk of injury, skin ulcers, abrasions, and burns

postmenopausal females are at a greater risk for urinary tract infections due to residual urine, urinary incontinence, and estrogen deficiency (Mody & Juthani-Mehta, 2014). Secondary changes, including malnutrition and poor circulation, as well as the breakdown of natural mechanical barriers such as the skin, place the aging immune system at even greater disadvantage against infection (Carlsson, Haglin, Rosendahl, et al., 2013).

The effects of the aging process and psychological stress interact, with the potential to negatively influence immune integrity (Epel & Lithgow, 2014). Consequently, continual assessment of the physical and emotional status of older adults is imperative, because early recognition and management of factors influencing immune response may prevent or mitigate the high morbidity and mortality seen with illness in the older adult population (Müller & Pawelec, 2014).

Nutrition

The relationship of infection to nutritional status is a key determinant of health. Traditionally, this relationship focused on the effect of nutrients on host defenses and the effect of infection on nutritional needs. This has expanded in scope to encompass the role of specific nutrients in acquired immune function—the modulation of inflammatory processes and the virulence of the infectious agent itself. Iron and the immune system are linked in homeostasis and pathology, thus making it essential for maximum function (Cassat & Skaar, 2013). The list of nutrients affecting infection, immunity, inflammation, and cell injury has expanded from traditional proteins to several vitamins, multiple minerals, and, more recently, specific lipid components of the diet. One review looked at the role of Vitamins A, C, D, E, and K in treatment of pancreatic cancer but concluded that not enough evidence based on clinical trials is available to fully support the use of these vitamins as an intervention (Davis-Yadley & Malafa, 2015). The role of micronutrients and fatty acids on the response of cells and tissues to hypoxic and toxic damage has been recognized, suggesting that there is another dimension to the relationship. Deficiencies in micronutrients have been connected to impairment in various body functions, including immunity. Zinc deficiency in particular has been linked to the development of a number of diseases. Zinc plays an important role in homeostasis, immune function, and apoptosis, among other functions (Müller & Pawelec, 2014).

The effects exerted by polyunsaturated fatty acids on immune system functions are under investigation. Studies suggest that these elements play a role in diminishing the incidence and severity of inflammatory disorders. Recent studies suggest that diets high in olive oil are not as immunosuppressive as diets rich in fish oil. The contribution of immune modulation by lipids to the high risk of infectious complications associated with the use of parenteral nutrition is unclear; however, a recent meta-analysis revealed that the use of glutamine-supplemented parenteral nutrition decreased the incidence of infections postoperatively (Yue, Tian, Wang, et al., 2013).

Depletion of protein reserves results in atrophy of lymphoid tissues, depression of antibody response, reduction in the number of circulating T cells, and impaired phagocytic function. As a result, susceptibility to infection is greatly increased. During periods of infection or serious illness, nutritional requirements may be further altered, potentially contributing to depletion of protein, fatty acid, vitamin, and trace elements and causing even greater risk of impaired immune response and sepsis. Nutritional intake that supports a competent immune response plays an important role in reducing the incidence of infections; patients whose nutritional status is compromised have a delayed postoperative recovery and often experience more severe infections and delayed wound healing. The nurse must assess the patient's nutritional status, caloric intake, and quality of foods ingested. There is evidence that nutrition plays a role in the development of cancer and that diet and lifestyle can alter the risk of cancer development as well as other chronic diseases (Supic, Jagodic, & Magic, 2013). The nurse must assume a proactive role in ensuring the best possible nutritional intake for all patients as a vital step in preventing disease and poor outcomes (Slawson, Fitzgerald, & Morgan, 2013).

Immunization

The patient is asked about childhood and adult immunizations, including vaccinations to provide protection against influenza, pneumococcal disease (Pneumovax), pertussis, herpes simplex, and the usual childhood diseases (e.g., measles, mumps). Herpes simplex virus infections have a significant impact on health, causing a wide range of diseases (e.g., oral and genital herpes). Education about the importance of adhering to the recommended schedule for adult vaccines should be initiated.

Infection

Known past or present exposure to tuberculosis is assessed, and the dates and results of any tuberculin tests (purified protein derivative [PPD] test) and chest x-rays are documented. Recent exposure to any infections and the exposure dates are elicited. The nurse must assess whether the patient has been exposed to any sexually transmitted infections (STIs) or blood-borne pathogens such as hepatitis B, C, and D viruses and human immune deficiency virus (HIV). A history of STIs such as gonorrhea, syphilis, human papillomavirus infection, and chlamydia can alert the nurse that the patient may have been exposed to HIV or hepatitis. Patients who have had an ischemic stroke or transient ischemic attack (TIA) are at risk for infection following the event (Ross, Lee, & Brewer, 2014). In an effort to fight infection, patients mount a peripheral immune response (PIR) consisting of neutrophilia, lymphocytopenia, and elevated monocytes (Ross et al., 2014). Researchers are investigating the time course, trajectory, and significance of the PIR following stroke or TIA (Ross et al., 2014); (Ross & Lee, 2015) (see Chart 54-4).

A history of past and present infections and the dates and types of treatments, along with a history of any multiple persistent infections, fevers of unknown origin, lesions or sores, or any type of drainage, as well as the response to treatment, are obtained.

Allergy

The patient is asked about any allergies, including types of allergens (e.g., pollens, dust, plants, cosmetics, food, medications, vaccines, latex), the symptoms experienced, and seasonal variations in occurrence or severity in the symptoms. A history of testing and treatments, including prescribed and over-the-counter medications that the patient has taken or is currently taking for these allergies and the effectiveness of the treatments, is obtained. All medication and food allergies are listed on an allergy alert sticker and placed on the front of the patient's health or medical record to alert others. Continued assessment for potential allergic reactions in the patient is vital. See Chapter 56 for more information on allergies.

Chart 54-4 NURSING RESEARCH PROFILE

Peripheral Immune Response Trajectories

Ross, A.M., & Lee, C. (2015). Description and identification of the peripheral immune response trajectories over time in first-time and recurrent stroke/transient ischemic attack. Journal of Neuroscience Nursing, 47(5), 256–262.

Purpose

It is not known how the immune response changes over time in patients after a stroke or transient ischemic attack (TIA). The purpose of this study was to describe the peripheral immune response (PIR) trajectories over time following a first-time and recurrent stroke or transient ischemic attack. The two aims were first to compare changes in the PIR over time in patients with a first versus a recurrent stroke or TIA, and second to identify trajectories of change in the PIR in patients after a stroke or TIA.

Design

This was a secondary analysis of data collected during a retrospective cross-sectional study on the PIR in the acute phase of care after a stroke or TIA. Data for the parent study were collected using a detailed retrospective medical record review. Descriptive statistics and latent growth mixture modeling were used to investigate the changes in PIR over time.

Findings

Of the 192 adult men and women included in the study 84 (44%) had a first-time stroke or TIA and 108 (56%) had a recurrent event. Participants with recurrent stroke or TIA had a persistent elevation in lymphocyte percentage compared to a significant decline in lymphocyte percentage observed in patients with a first-time event. The first trajectory (80% of the sample) had persistently lower lymphocyte percentages and higher neutrophil percentages over time, while the second trajectory (20% of the sample) had higher lymphocyte percentages and lower neutrophil percentages over time.

Nursing Implications

Nurses monitoring laboratory values after stroke or TIA need to recognize that different trajectories of PIRs exist. This may have future implications for identification of patients who may benefit from novel immune therapies. Nurses caring for patients who have any signs of depressed immune function need to be more vigilant in their assessments, watching for possible signs and symptoms of infection.

Disorders and Diseases

Autoimmune Disorders

Autoimmune disorders affect people of both genders of all ages, ethnicities, and social classes. Autoimmune disorders are a group of disorders that can affect almost any cell or tissue in the body (Grossman & Porth, 2014). As mentioned previously, they tend to be more common in women because estrogen tends to enhance immunity. Androgen, on the other hand, tends to be immunosuppressive. Autoimmune diseases are a leading cause of death by disease in females of reproductive age.

The patient is asked about any autoimmune disorders, such as lupus erythematosus, rheumatoid arthritis, multiple sclerosis, or psoriasis. The onset, severity, remissions and exacerbations, functional limitations, treatments that the patient has received or is currently receiving, and effectiveness of the treatments are described. The occurrence of different autoimmune diseases within a family strongly suggests a genetic predisposition to more than one autoimmune disease (Brooks & Renaudineau, 2015) (see Chart 54-5).

Neoplastic Disease

If there is a history of cancer in the family, more information is obtained, including the type of cancer, age at onset, and relationship (maternal or paternal) of the patient to the affected family members. Dates and results of any cancer screening tests for the patient are documented.

A history of cancer in the patient is also obtained, along with the type of cancer, date of diagnosis, and treatment modalities used. Immunosuppression contributes to the development of cancers; however, cancer itself is immunosuppressive, as is the treatment for cancer. Large tumors can release antigens into the blood, and these antigens combine with circulating antibodies and prevent them from attacking the tumor cells. Furthermore, tumor cells may possess special blocking factors that coat tumor cells and prevent their destruction by killer T lymphocytes. During the early development of tumors, the body may fail to recognize the tumor antigens as foreign and subsequently fail to initiate destruction of the malignant cells. Hematologic cancers, such as leukemia and lymphoma, are associated with altered production and function of WBCs and lymphocytes.

All treatments that the patient has received or is currently receiving, such as radiation or chemotherapy, are recorded in the health history. In addition, the nurse should elicit information related to complementary or alternative modalities that have been used and the response to these efforts. Radiation destroys lymphocytes and decreases the ability to mount an effective immune response. The size and extent of the irradiated area determine the extent of immunosuppression. Whole-body irradiation may leave the patient totally immunosuppressed. Chemotherapy and other cancer treatments also affect bone marrow function, destroying cells that contribute to an effective immune response and resulting in immunosuppression (Morrison, 2014).

Chronic Illness and Surgery

The health assessment includes a history of chronic illness, such as diabetes, renal disease, chronic obstructive pulmonary disease (COPD), or fibromyalgia. The onset and severity of illnesses, as well as treatment that the patient is receiving for the illness, are obtained. Chronic illness may contribute to immune system impairments in various ways. Kidney injury is associated with a deficiency in circulating lymphocytes. In addition, immune defenses may be altered by acidosis and uremic toxins. In diabetes, an increased incidence of infection has been associated with vascular insufficiency, neuropathy, and poor control of serum glucose levels. Recurrent respiratory tract infections are associated with COPD as a result of altered inspiratory and expiratory function and ineffective airway clearance. In addition, a history of organ transplantation or surgical removal of the spleen, lymph nodes, or thymus is noted, because these conditions may place the patient at risk for impaired immune function (Bronte & Pittet, 2013).

Special Problems

Conditions such as burns and other forms of injury and infection may contribute to altered immune system function. Major burns

Chart 54-5 GENETICS IN NURSING PRACTICE

Immunologic Disorders

An immunologic disorder is a disorder of an individual's immune system, which is a network of cells, tissues, and organs that work together to defend the body against attacks by foreign invaders such as bacteria, parasites, and fungi that can cause infection. A number of immunologic disorders have a known inheritance pattern, while others are noted to have a genetic abnormality that is influenced by environmental exposures. Therefore, the pattern of inheritance is unclear in some immunologic disorders. Examples of immunologic disorders caused by a genetic abnormality include:

- Adenosine deaminase deficiency (autosomal recessive)
- Alopecia areata
- Alopecia totalis
- Asthma
- Ataxia telangiectasia (autosomal recessive)
- Autoimmune polyglandular syndrome
- Bruton agammaglobulinemia (X linked)
- Burkitt lymphoma
- Crohn's disease
- Diabetes, type 1
- DiGeorge syndrome (Autosomal dominant)
- Familial Mediterranean fever
- Job syndrome (autosomal dominant and recessive)
- Purine nucleoside phosphorylase deficiency (autosomal dominant)
- Severe combined immunodeficiency (primarily X linked)
- Wiskott–Aldrich syndrome (X linked)

Nursing Assessments

Family History Assessment Specific to Immunologic Disorders

- Collect a family history for both maternal and paternal relatives for three generations.
- Assess family history for other family members with histories of immunologic disorders.
- Obtain information about family members with a history of recurrent infections or illness.
- Recognize ethnic risk (non-Ashkenazi Jewish, Armenian, Arab, and Turkish are at greater risk for Familial Mediterranean fever; Caucasians have a higher incidence of Crohn's disease)
- Assess genetic and inherited pattern of any disease
  - Similar disorder in two or more close relatives
  - History of miscarriages, birth defects, and developmental delays
  - History of consanguineous marriage

Patient Assessment

- Assess for symptoms such as changes in respiratory status associated with asthma (e.g., wheezing, or airway hyperresponsiveness; mucosal edema; and mucus production).
- Gather information regarding immunizations and whether an altered response to any immunization has occurred.
- Assess for symptoms of immunodeficiency disorders, such as unexplained weight gain or loss, skin rashes, changes in hair texture or distribution, joint or muscle pain, intolerance to cold, irregular menstrual periods, abdominal discomfort, or the presence of diarrhea.
- Identify pattern of sickness with regard to frequency of colds, respiratory infections, or history of illness that tends to linger.
- Obtain history of childhood illnesses and details of the illness experience.
- Assess for medical history of frequent or recurrent infections.
- Learn about susceptibility to infections, assess for patterns (frequency, length of illness, severity of symptoms), and recognize infections that would be atypical for age.
- Inquire about environmental exposures (e.g., smoke, chloroform, metal or dust particles, paint).
- Ask about exposure to other viruses such as Epstein Barr or Influenza.

Resources

American Autoimmune Related Diseases Association, www.aarda.org
Genetic and Rare Diseases Information Center, rarediseases.info.nih.gov

cause impaired skin integrity and compromise the body's first line of defense. Loss of large amounts of serum occurs with burn injuries and depletes the body of essential proteins, including immunoglobulins. The physiologic and psychological stressors associated with surgery or injury stimulate cortisol release from the adrenal cortex; increased serum cortisol also contributes to suppression of normal immune responses (Eng, Kokolus, Reed, et al., 2014).

Medications and Blood Transfusions

A list of past and present medications is obtained. In large doses, antibiotics, corticosteroids, cytotoxic agents, salicylates, nonsteroidal anti-inflammatory drugs, and anesthetic agents can cause immune suppression (see Table 54-5).

A history of blood transfusions is obtained, because previous exposure to foreign antigens through transfusion may be associated with abnormal immune function. In addition, although the risk of HIV transmission through blood transfusion is extremely low in patients, still some risk remains.

The patient is also asked about the use of herbal agents and over-the-counter medications. Because many of these products have not been subjected to rigorous testing, their effects have not been fully identified. It is important, therefore, to ask patients about their use of these substances, to document their use, and to educate patients about untoward effects that may alter immune responsiveness.

Lifestyle Factors

Like any other body system, the functions of the immune system are interrelated with other body systems. Poor nutritional status, smoking (Sheils, Katki, Freedman, et al., 2014), excessive consumption of alcohol, illicit drug use, STIs, and occupational or residential exposure to environmental radiation and pollutants have been associated with impaired immune function and are assessed in a detailed patient history. Although factors that are not consistent with a healthy lifestyle are predominately responsible for ineffective immune function, positive lifestyle factors can also negatively affect immune function and require assessment. For example, rigorous exercise or competitive exercise—usually considered a positive lifestyle factor—can be a physiologic stressor and cause negative effects on immune response (Jin, Paik, Kwak, et al., 2015). This outcome is compounded if the person also faces stressful environmental conditions while undergoing exercise. Given the cumulative impact of various environmental stressors on the immune system, every effort should be made to minimize the person's exposure to stressors other than the exercise performed (Jin et al., 2015).

Psychoneuroimmunologic Factors

Patient assessment must also address psychoneuroimmunologic factors. The bidirectional pathway between the brain and

TABLE 54-5 Selected Medications and Effects on the Immune System

Drug Classification (and Examples)	Effects on the Immune System
Antibiotics (in large doses)	**Bone marrow suppression**
Ceftriaxone (Rocephin)	Eosinophilia, hemolytic anemia, hypoprothrombinemia, neutropenia, thrombocytopenia
Cefuroxime sodium (Ceftin)	Eosinophilia, hemolytic anemia, hypoprothrombinemia, neutropenia, thrombocytopenia
Chloramphenicol (Chloromycetin)	Leukopenia, aplastic anemia
Dactinomycin (Cosmegen)	Agranulocytosis, neutropenia
Fluoroquinolones (ciprofloxacin [Cipro], levofloxacin [Levaquin])	Hemolytic anemia, methemoglobinemia, eosinophilia, leukopenia, pancytopenia
Gentamicin sulfate (Garamycin)	Agranulocytosis, granulocytosis
Macrolides (erythromycin, Azithromycin [Zithromax], Clarithromycin [Biaxin])	Neutropenia, leukopenia
Penicillins	Agranulocytosis
Streptomycin	Leukopenia, neutropenia, pancytopenia
Vancomycin (Vancocin, Vancoled)	Transient leukopenia
Antithyroid Drugs	
Propylthiouracil (PTU)	Agranulocytosis, leukopenia
Nonsteroidal Anti-Inflammatory Drugs (NSAIDs) (in large doses)	**Inhibit Prostaglandin Synthesis or Release**
Aspirin	Agranulocytosis
COX-2 inhibitors (celecoxib [Celebrex])	Anemia, allergy, no other major adverse effects
Ibuprofen (Advil, Motrin)	Leukopenia, neutropenia
Indomethacin (Indocid, Indocin)	Agranulocytosis, leukopenia
Phenylbutazone	Pancytopenia, agranulocytosis, aplastic anemia
Adrenal Corticosteroids	**Immunosuppression**
Prednisone	Immunosuppression
Antineoplastic Agents (cytotoxic agents)	**Immunosuppression**
Cyclophosphamide (Cytoxan)	Leukopenia, neutropenia
Mechlorethamine HCl (Mustargen)	Agranulocytosis, neutropenia
Cyclosporine (Neoral)	Leukopenia, inhibits T-lymphocyte function
Antimetabolites	**Immunosuppression**
Pyrimidine antagonist (Fluorouracil [5-FU])	Leukopenia, eosinophilia
Folic acid antagonist (Methotrexate)	Leukopenia, aplastic bone marrow
Purine antagonist (Mercaptopurine[(6-MP])	Leukopenia, pancytopenia

COX, cyclo-oxygenase.

Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

immune system is referred to as psychoneuroimmunology (Fagundes, Lindgren, & Kiecolt-Glaser, 2013). The immune response is regulated and modulated in part by neuroendocrine influences. Lymphocytes and macrophages have receptors that can respond to neurotransmitters and endocrine hormones. Lymphocytes can produce and secrete adrenocorticotropic hormone and endorphine-like compounds. Cells in the brain, especially in the hypothalamus, can recognize prostaglandins, interferons, and interleukins, as well as histamine and serotonin, all of which are released during the inflammatory process. Like all other biologic systems functioning to maintain homeostasis, the immune system is integrated with other psychophysiologic processes and is regulated and modulated by the brain. These relationships may have immunologic consequences.

Conversely, the immune processes can affect neural and endocrine function, including behavior. Growing evidence indicates that a measurable immune system response can be positively influenced by biobehavioral strategies such as relaxation and imagery techniques, biofeedback, humor, hypnosis, and conditioning (Bennett, Parsons, Ben-Moshe, et al., 2014); (Palsson & van Tilburg, 2015). Therefore, the assessment should address the patient's general psychological status and the patient's use of and response to these strategies.

Physical Assessment

During the physical examination (see Chart 54-3), the skin and mucous membranes are assessed for lesions, dermatitis, purpura (subcutaneous bleeding), urticaria, inflammation, or any discharge. Any signs of infection are noted. The patient's temperature is recorded, and the patient is observed for chills and sweating. The anterior and posterior cervical, supraclavicular, axillary, and inguinal lymph nodes are palpated for enlargement; if palpable nodes are detected, their location, size, consistency, and reports of tenderness on palpation are noted. Joints are assessed for tenderness, swelling, increased warmth, and limited range of motion. The patient's respiratory, cardiovascular, genitourinary, gastrointestinal, and neurosensory systems are evaluated for signs and symptoms indicative of immune dysfunction. Any functional limitations or disabilities the patient may have are also assessed.

Diagnostic Evaluation

A series of blood tests and skin tests, as well as bone marrow biopsy, may be performed to evaluate the patient's immune competence. Specific laboratory and diagnostic tests are discussed in greater detail along with individual disease processes in subsequent chapters in this unit. Selected laboratory

Chart 54-6

Selected Tests for Evaluating Immunologic Status

Various laboratory tests may be performed to assess immune system activity or dysfunction. The studies assess leukocytes and lymphocytes, humoral immunity, cellular immunity, phagocytic cell function, complement activity, hypersensitivity reactions, specific antigen–antibodies, or human immunodeficiency virus infection.

Humoral (Antibody-Mediated) Immunity Tests

- B-cell quantification with monoclonal antibody
- In vivo immunoglobulin synthesis with T-cell subsets
- Specific antibody response
- Total serum globulins and individual immunoglobulins (electrophoresis, immunoelectrophoresis, single radial immunodiffusion, nephelometry, and isohemagglutinin techniques)

Cellular (Cell-Mediated) Immunity Tests

- Total lymphocyte count
- T-cell and T-cell-subset quantification with monoclonal antibody
- Delayed hypersensitivity skin test
- Cytokine production
- Lymphocyte response to mitogens, antigens, and allogenic cells
- Helper and suppressor T-cell functions

and diagnostic tests used to evaluate immune competence are summarized in Chart 54-6.

Nursing Management

The nurse needs to be aware that patients undergoing evaluation for possible immune system disorders experience not only physical pain and discomfort with certain types of diagnostic procedures but also many psychological reactions. It is the nurse's role to counsel, educate, and support patients throughout the diagnostic process. Many patients may be extremely anxious about the results of diagnostic tests and the possible implications of those results for their future health, employment, and personal relationships. This is an ideal time for the nurse to provide counseling and education, should these interventions be warranted.

CRITICAL THINKING EXERCISES

1. An 80-year-old woman presents to her primary provider for evaluation of a recurrent urinary tract infection for which she has received several courses of antibiotics. What diagnostic tests would you expect to be prescribed? What is the rationale for these tests? What further assessment data would you want to obtain from this patient?
2. A 40-year-old woman with systemic lupus erythematosus (SLE) is admitted to the hospital for a kidney transplant and is prescribed immunosuppressant medications. Describe how her altered immune system would affect the care you provide. Develop an evidence-based education plan for the patient and her family before hospital discharge. Discuss the criteria used to assess the strength of the evidence for your education plan.
3. A 35-year-old woman with rheumatoid arthritis presents with an acute flare-up of her symptoms and is prescribed corticosteroids. What are your priority nursing observations and assessments? Identify priorities for patient education appropriate for the new prescription of steroids.

REFERENCES

*Asterisk indicates nursing research.

Books

Comerford, K. C. (Ed.) (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Fagundes, C. P., Lindgren, M. E., & Kiecolt-Glaser, J. K. (2013). Psychoneuroimmunology and cancer: Incidence, progression, and quality of life. In B. I. Carr, & J. Steel (Eds.). Psychological aspects of cancer: A guide to emotional and psychological consequences of cancer, their causes and their management. New York: Springer.

Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Haynes, B. F., Soderberg, K. A., & Fauci, A. S. (2015). Introduction to the immune system. In D. L. Kasper, A. S. Fauci, S. L. Hauser, et al. (Eds.). Harrison's principles of internal medicine (19th ed.). New York: McGraw-Hill Education.

Kessler, J. A. (2015). Applications of stem cell biology in clinical medicine. In D. L. Kasper, A. S. Fauci, S. L. Hauser, et al. (Eds.). Harrison's principles of internal medicine (19th ed.). New York: McGraw-Hill Education.

Levinson, W. (2014). Review of medical microbiology and immunology (13th ed.). New York: McGraw-Hill Education.

McComb, S., Thiriot, A., Krishnan, L., et al. (2013). Introduction to the immune system. In K. M. Fulton, & S. M. Twine (Eds.). Immunoproteomics: Methods and protocols. Totowa: Humana Press.

Page, A. V., & Liles, W. C. (2015). Immunomodulators. In J. E. Bennett, R. Dolin, & M. J. Blaser (Eds.). Principles and practices of infectious diseases (8th ed.). Philadelphia, PA: Elsevier Saunders.

Paul, W. E. (Ed.) (2013). Fundamental immunology (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Shekarabi, M., & Asgari, F. (2014). Aging immunity and infection. In A. N. Massoud, & N. Rezaei (Eds.). Immunology of aging. New York: Springer Heidelberg.

Journals and Electronic Documents

Bennett, P. N., Parsons, T., Ben-Moshe, R., et al. (2014). Laughter and humor therapy in dialysis. Seminars in Dialysis, 27(5), 488–493.

Booy, S., Hofland, L., & van Eijck, C. (2015). Potentials of interferon therapy in the treatment of pancreatic cancer. Journal of Interferon and Cytokine Research, 35(5), 327–339.

Bronte, V., & Pittet, M. J. (2013). The spleen in local and systemic regulation of immunity. Immunity, 39(5), 809–818.

Brooks, W. H., & Renaudineau, Y. (2015). Epigenetics and autoimmune diseases: The X chromosome-nucleolus nexus. Frontiers in Genetics, 6(22), 1–20.

Carlsson, M., Haglin, L., Rosendahl, E., et al. (2013). Poor functional status is associated with urinary tract infection among older people living in residential care facilities. The Journal of Nutrition, Health & Aging, 17(2), 186–191.

Cassat, J. E., & Skaar, E. P. (2013). Iron in infection and immunity. Cell Host & Microbe, 13(5), 509–519.

Davis-Yadley, A. H., & Malafa, M. P. (2015). Vitamins in pancreatic cancer: A review of underlying mechanisms and future applications. Advances in Nutrition, 6, 774–802.

Eng, J. W., Kokolus, K. M., Reed, C. B., et al. (2014). A nervous tumor microenvironment: The impact of adrenergic stress on cancer cells, immunosuppression, and immunotherapeutic response. Cancer Immunology and Immunotherapy, 63(11), 1115–1128.

Epel, E. S., & Lithgow, G. J. (2014). Stress biology and aging mechanisms: Toward understanding the deep connection between adaptation to stress and longevity. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 69(Suppl 1), S10–S16.

Geering, B., & Fussenegger, M. (2015). Synthetic immunology: Modulating the human immune system. Trends in Biotechnology, 33(2), 65–79.

Glassman, P. M., & Balthasar, J. P. (2014). Mechanistic considerations for the use of monoclonal antibodies for cancer therapy. Cancer Biology & Medicine, 11(1), 20–33.

Goronzy, J. J., & Weyand, C. M. (2013). Understanding immunosenescence to improve responses to vaccines. Nature Immunology, 14, 428–436.

Jin, C.H., Paik, I.Y., Kwak, Y.S., et al. (2015). Exhaustive submaximal endurance and resistance exercises induce temporary immunosuppression via physical and oxidative stress. Journal of Exercise and Rehabilitation, 11(4), 198–203.

Kannan, R., Madden, K., & Andrews, S. (2013). Primer on immune-oncology and immune response. Clinical Journal of Oncology Nursing, 18(3), 311–317.

Lo, Y.C., Lee, C. F., & Powell, J. D. (2014). Insight into the role of mTOR and metabolism in T cells reveals new potential approaches to preventing graft rejection. Current Opinion in Organ Transplantation, 19(4), 363–371.

Mody, L., & Juthani-Mehta, M. (2014). Urinary tract infections in older women: A clinical review. JAMA, 311(8), 844–854.

Morrison, V. (2014). Immunosuppression associated with novel chemotherapy agents and monoclonal antibodies. Clinical Infectious Diseases, 59(Suppl 5), S360–S364.

Müller, L., & Pawelec, G. (2014). Aging and immunity: Impact of behavioral intervention. Brain, Behavior, and Immunity, 39, 8–22.

Ngo, S. T., Steyn, F. J., & McCombe, P. A. (2014). Gender differences in autoimmune disease. Frontiers in Neuroendocrinology, 35(3), 347–369.

Palsson, O. S., & van Tilburg, M. (2015). Hypnosis and guided imagery treatment for gastrointestinal disorders: Experience with scripted protocols developed at the University of North Carolina. American Journal of Clinical Hypnosis, 58(1), 5–21.

*Ross, A. M., & Lee, C. (2015). Description and identification of the peripheral immune response trajectories over time in first-time and recurrent stroke/transient ischemic attack. Journal of Neuroscience Nursing, 47(5), 256–262.

*Ross, A. M., Lee, C. S., & Brewer, M. (2014). Peripheral immune response and infection in first-time and recurrent ischemic stroke or transient ischemic attack. Journal of Neuroscience Nursing, 46(4), 199–206.

Sheils, M. S., Katki, H. A., Freedman, N. D., et al. (2014). Cigarette smoking and variations in systemic immune and inflammation markers. Journal of the National Cancer Institute, 106(11), 1–8.

Slawson, D. L., Fitzgerald, N., & Morgan, K. T. (2013). Position of the academy of nutrition and dietetics: The role of nutrition in health promotion and chronic disease prevention. Journal of the Academy of Nutrition and Dietetics, 113(7), 972–979.

Supic, C., Jagodic, M., & Magic, Z. (2013). Epigenetics: A new link between nutrition and cancer. Nutrition and Cancer, 65(6), 781–792.

Yue, C., Tian, W., Wang, W., et al. (2013). The impact of perioperative glutamine-supplemented parenteral nutrition on outcomes of patients undergoing abdominal surgery: A meta- analysis of randomized clinical trials. The American Surgeon, 79(5), 506–513.

Resources

American Cancer Society, www.cancer.org

Centers for Disease Control and Prevention, www.cdc.gov

National Institute of Allergy and Infectious Diseases, www.niaid.nih.gov/

National Institutes of Health, Health Information, www.nih.gov/health/infoline.htm

U.S. Department of Health and Human Services, www.hhs.gov

CHAPTER 55

Management of Patients with Immune Deficiency Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Identify the pathophysiology, clinical manifestations, and nursing management of patients with primary immune deficiency disorders (PIDD).
2. Describe the modes of transmission of human immune deficiency virus (HIV) infection and prevention strategies.
3. Explain the pathophysiology associated with the clinical manifestations of HIV and Acquired Immune Deficiency Syndrome (AIDS) and the purpose of antiretroviral therapy (ART).
4. Use the nursing process as a framework for care of the patient with HIV/AIDS.
5. Identify resources available to patient and family that promote self-management of immune deficiency disorders.

GLOSSARY

candidiasis: fungal infection, usually of skin or mucous membranes, caused by Candida species
enzyme immunoassay (EIA): a blood test that can determine the presence of antibodies to HIV in the blood or saliva; a variant of this test is called enzyme-linked immunosorbent assay (ELISA)
HIV-1: Human immunodeficiency virus 1 is a specific type of retrovirus isolated and recognized as the etiologic agent of acquired immunodeficiency syndrome
HIV encephalopathy: clinical syndrome characterized by a progressive decline in cognitive, behavioral, and motor functions
immune reconstitution inflammatory syndrome (IRIS): a syndrome that results from rapid restoration of pathogen-specific immune responses to opportunistic infections
Kaposi sarcoma: malignancy that involves the epithelial layer of blood and lymphatic vessels commonly found among HIV-infected persons
latent reservoir: the integrated HIV provirus within the $CD4^+$ T cell during the resting memory state; does not express viral proteins and is invisible to the immune system and antiviral medications
Mycobacterium avium complex (MAC): opportunistic infection caused by mycobacterial organisms that commonly causes a respiratory illness but can also infect other body systems
opportunistic infection: illness caused by various organisms, some of which usually do not cause disease in people with normal immune systems
peripheral neuropathy: disorder characterized by sensory loss, pain, muscle weakness, and wasting of muscles in the hands or legs and feet
Pneumocystis pneumonia (PCP): common opportunistic lung infection; pathogen implicated is most commonly a fungus
polymerase chain reaction: a sensitive laboratory technique that can detect and quantify HIV in a person's blood or lymph nodes
post-exposure prophylaxis (PEP): taking antiretroviral medicines as soon as possible, but no more than 72 hours (3 days) after possible HIV exposure; two to three drugs are usually prescribed which must be taken for 28 days.
pre-exposure prophylaxis (PrEP): prevention method for HIV-negative people who are at high risk of HIV infection; involves taking a specific combination of HIV medicines daily; use with condoms and other prevention tools.
progressive multifocal leukoencephalopathy: opportunistic infection that infects brain tissue and causes damage to the brain and spinal cord
retrovirus: a virus that carries genetic material in ribonucleic acid (RNA) instead of DNA and contains reverse transcriptase
reverse transcriptase: enzyme that transforms single-stranded RNA into a double-stranded DNA
viral load test: measures the quantity of HIV RNA or DNA in the blood
viral set point: amount of virus present in the blood after the initial burst of viremia and the immune response that follows
wasting syndrome: involuntary weight loss consisting of both lean and fat body mass

Introduction

The human immune system is complex and multidimensional. It works to protect against invasion by foreign substances, protect against the proliferation of neoplastic cells, and plays a key role in inflammation and healing. Patients with primary or secondary immune system disorders require care from nurses who are knowledgeable about the pathophysiology, diagnostic procedures, and interventions that are used in the management of these disorders.

PRIMARY IMMUNE DEFICIENCIES

The majority of primary immune deficiency diseases (PIDDs) are diagnosed in infancy, with a male-to-female ratio of 5 to 1. However, some PIDDs are not diagnosed until adolescence or early adulthood, when the gender distribution equalizes. Diagnosis at this stage frequently is confounded by frequent use of antibiotics that mask symptoms. On occasion, adults present with clinical episodes of infectious diseases that are beyond the scope of normal immunocompetence. Examples include infections that are unusually persistent, recurrent, or resistant to treatment and those involving unexpected dissemination of disease or atypical pathogens.

Pathophysiology

More than 270 different genes are associated with PIDDs that are recognized by the International Union of Immunological Societies (Hernandez-Trujillo, Orange, Roy, et al., 2015). These rare genetic diseases prevent the body from developing normal

immune responses resulting in a complex group of disorders with a wide array of clinical presentations. Many present during the first year of life and may be chronic, debilitating, and costly (National Institute of Allergies and Infectious Diseases [NIAID], 2015).

Clinical Manifestations

Major signs and symptoms include multiple infections despite aggressive treatment, infections with unusual or opportunistic organisms, failure to thrive or poor growth, and a positive family history (Costa-Carvalho, Grumach, Franco, et al., 2014). Table 55-1 contains selected PIDDs along with some of their clinical manifestations.

Assessment and Diagnostic Findings

There is often a considerable delay between the onset of symptoms and time of diagnosis of PIDD (Lehman, Hernandez-Trujillo, & Ballow, 2015). Because of the genetic origins of PIDD, family history should be carefully assessed but epidemiologic data about specific infectious agents should be considered as well (Costa-Carvalho et al., 2014).

Laboratory tests are used to identify antibody deficiencies, cellular (T-cell) defects, neutrophil disorders and complement deficiencies (Blaese, Stiehm, Bonilla, et al., 2013). A complete blood cell count with manual differential should always be analyzed first. Lymphopenia may indicate an immunologic abnormality; serum Ig levels (IgG, IgM, and IgA) and antibody responses to vaccines should be assessed to detect a humoral immune defect. Age-matched normal ranges need to be used since antibody levels change as the person ages (Younger, Epland, Zampelli, et al., 2015).

Prevention

Live vaccines are contraindicated in patients with antibody deficiency disorders (Younger et al., 2015). The patient is incapable of generating antibodies and the live substance in the vaccine can cause disease. Family planning should be addressed in terms of future pregnancies; in some situations, prenatal in utero testing of a fetus can determine whether the infant will be affected (Blaese et al., 2013).

Medical Management

A pattern of unusually frequent, opportunistic, or severe infections generates the possibility of a PIDD and initial testing or referral to an immunologist (Younger et al., 2015). Patients with neutropenia are at increased risk for developing severe infections despite substantial advances in supportive care. Epidemiologic shifts occur periodically and must be detected early because they influence prophylactic, empiric, and specific strategies for medical management. Attention to infection control practices is important, especially with the emergence of multidrug-resistant organisms.

Hematopoietic stem cell transplantation (HSCT) is a curative modality. The stem cells may be from embryos or adults. Toxicity and reduced efficacy are frequent limitations of HSCT. See Chapter 58 for further discussion of HSCT.

Another therapy involves the use of cells as vehicles for the delivery of genes or gene products. Gene therapy has had many adverse effects; the first studies in human participants revealed numerous toxicities with this therapy. Knowledge of these toxicities is being used in planning further studies to increase tolerability (Blaese et al., 2013).

Pharmacologic Therapy

Pharmacologic treatment depends upon the type and severity of presenting infection and the particular PIDD diagnosis (see Table 55-1). Prophylactic drug treatment prevents some bacterial and fungal infections but it must be used with caution because it has been implicated in the emergence of resistant organisms. The choices for empiric therapy include combination regimens and monotherapy. Specific choices depend on local factors (epidemiology, susceptibility/resistance patterns, availability, cost). Patients with antibody deficiencies receive regular Ig replacement therapy including both IV immunoglobulin (IVIG) and subcutaneous immunoglobulin (SCIG) to provide functional antibodies (Cherin, Marie, Michallet, et al., 2016).

The procedural guidelines for management of IVIG are described in Procedural Guidelines 55-1.

Nursing Management

Many patients with PIDDs have comorbid autoimmune disorders, such as thyroid disease, rheumatoid arthritis, cytopenias, and inflammatory bowel disease (Younger et al., 2015). Many patients require immunosuppression to ensure engraftment of depleted bone marrow during transplantation procedures. For this reason, nursing care must be meticulous. Appropriate hand hygiene and infection prevention precautions are essential. See Chapter 1, Chart 1-4 for hand hygiene methods and Chart 1-5 for a summary of infection prevention precautions. Institutional policies and procedures related to infection prevention care must be followed scrupulously until definitive evidence demonstrates that precautions are unnecessary. Continual monitoring of the patient's condition is critical, so early signs of impending infection may be detected and treated before they seriously compromise the patient's status.

Patients and caregivers in the home are taught how to administer medications, including regular Ig replacement therapy, if prescribed. Instruction is provided to the patient and family about how to administer the therapy at home (see Chart 55-1). Nurses provide ongoing education and support for the patient and family.

ACQUIRED IMMUNE DEFICIENCY

Immune deficiency can be acquired due to medical treatment such as chemotherapy (see Chapter 58) or infection from agents such as human immune deficiency virus (HIV). Advances have been made in treating HIV infection and acquired immune deficiency syndrome (AIDS); however, AIDS remains a critical public health issue in communities across the country and around the world. Prevention, early detection, and ongoing treatment remain important aspects of care for persons living with HIV infection or AIDS, sometimes referred to as PLHIV.

HIV Infection and AIDS

Since the disease now known as AIDS was first identified more than 35 years ago, remarkable progress has been made

TABLE 55-1 Selected Primary Immune Deficiency Disorders (PIDDs)

Disorder	Characteristics
Autoimmune lymphoproliferative syndrome (ALPS)	Unusually high numbers of lymphocytes accumulate in the lymph nodes, liver, and spleen leading to enlargement of those organs. Causes numerous autoimmune problems including low levels of red blood cells, platelets, and neutrophils.
Autoimmune polyglandular syndrome type 1 (APS-1). (also called autoimmune polyendocrinopathy-candidiasis-ectodermal dystrophy [APECED])	Causes a diverse range of symptoms, including autoimmunity against different types of organs and candidiasis, a fungal infection caused by *Candida* yeast.
CARD9 Deficiency and other syndromes of susceptibility to candidiasis	Results in susceptibility to fungal infections such as candidiasis; fungi are usually present on the skin; does not cause severe problems in healthy people.
Chronic granulomatous disease (CGD)	May be caused by mutations in one of five different genes. Phagocytes are unable to kill certain bacteria and fungi resulting in increased susceptibility to infections.
Common variable immunodeficiency (CVID)	Caused by a variety of genetic abnormalities resulting in defective ability of immune cells to produce normal amounts of antibodies, resulting in frequent bacterial or viral infections of the upper airway, sinuses, and lungs.
Congenital neutropenia syndromes	Characterized by low levels of neutrophils from birth.
CTLA4 Deficiency	Autoimmunity, low levels of antibodies, and excessive numbers of lymphocytes which infiltrate the gut, lungs, bone marrow, central nervous system, kidneys resulting in recurrent infections.
DOCK8 Deficiency	Genetic defect named after mutated gene responsible for the disease which causes decreased numbers and defective function of immune cells and recurrent infections.
GATA2 Deficiency	Can manifest as five different syndromes with a wide variety of symptoms including severe infections, respiratory problems, hearing loss, leg swelling, and cancer. These symptoms can appear early in childhood but also later on in life.
Glycosylation disorders with immune deficiency	Defects in glycosylation, which refers to the attachment of sugars to proteins; can disrupt the immune system resulting in immune deficiency.
Hyper-immunoglobulin E syndrome (HIES). Also called Job syndrome	Results from mutations in a gene that encodes a signaling module called STAT3 resulting in recurrent bacterial infections of skin and lungs.
Hyper-immunoglobulin M (hyper-IgM) syndromes	Immune system fails to produce normal IgA, IgG, and IgE antibodies but can produce normal or elevated IgM. Infants usually develop severe respiratory infections.
Interferon gamma, interleukin 12, interleukin 23 deficiencies	Interferon gamma, interleukin 12, and interleukin 23 are key signals that raise alert against bacteria and other infectious microbes; deficiencies result in susceptibility to infections caused by bacteria and viruses.
Leukocyte adhesion deficiency (LAD)	Phagocytes are unable to move to the site of an infection resulting in an inability to fight pathogens resulting in recurrent, life-threatening infections and poor wound healing.
NF-kB Essential modifier (NEMO) mutations	Mutations in the NEMO gene cannot "turn on" other genes especially those involved in inflammation and the immune response and are, therefore, highly susceptible to infections with mycobacteria.
PI3 Kinase disease	Genetic mutations overactivate an important immune signaling pathway causing a change reaction that disrupts the infection-fighting B and T cells resulting in a weakened immune system and frequent bacterial and viral infections.
PLCG2-associated antibody deficiency and immune dysregulation (PLAID)	Rare disorder with allergic response to cold (cold urticaria) as the most distinct symptom.
Severe combined immune deficiency (SCID)	Group of rare, life-threatening disorders caused by mutations in different genes involved in development and function of T and B cells; infants appear healthy at birth but are highly susceptible to severe infections.
Warts, hypogammaglobulinemia, infections, and myelokathexis syndrome (WHIMS)	Low levels of white blood cells, especially neutrophils, which predispose to frequent infections and persistent warts.
Wiskott–Aldrich syndrome (WAS)	Problems with B and T cells and platelets resulting in prolonged episodes of bleeding, recurrent bacterial and fungal infections and increased risk of cancers and autoimmune diseases.

Adapted from National Institute of Allergies and Infectious Diseases (2015). Types of primary immune deficiency disorders. Retrieved on 5/10/1016 at: www.niaid.nih.gov/topics/immuneDeficiency/Pages/majorPIDDs.aspx.

Procedural Guideline 55-1

Managing Immunoglobulin Therapy

Immunoglobulin therapy is an important treatment for a variety of disease states that are characterized by deficient production of antibodies. Immunoglobulin can be administered for replacement therapy as an IV infusion or subcutaneous (SC) injection. It can safely be administered in outpatient as well as inpatient settings.

Equipment (as Needed)

- Single-use tourniquet
- Single-use scissors or clippers for hair removal
- IVIG solution, tubing, connector, catheter, or syringe
- Chlorhexidine gluconate, povidone–iodine, or alcohol swabs
- Nonlatex gloves
- Transparent dressing, bandage, or sterile gauze
- Padded, appropriate-length arm board
- Tape
- Topical analgesics
- Preservative-free 0.9% NaCl flush solution
- Electronic infusion pump

Implementation

Nursing Actions	Rationale
1. Verify prescription for IVIG therapy and identify patient.	1. Serious errors can be avoided by careful checking. Immunoglobulin is supplied in a 5% solution or a lyophilized powder with a reconstituting diluent prepared from Cohn fraction II obtained from pools of 1,000–20,000 donors. Currently, a number of different IV preparations are approved for use and have been shown to be effective and safe by the U.S. Food and Drug Administration. Immunoglobulin can also be administered via SC injection.
2. Check for allergies (i.e., latex, iodine).	2. Checking for allergies reduces risk of allergic reaction.
3. Explain procedure to patient.	3. Knowledge increases patient comfort and cooperation.
4. Perform hand hygiene, and put on disposable nonlatex gloves.	4. Asepsis is essential to prevent infection. The use of nonlatex gloves prevents exposure of nurse to patient's blood and of patient and nurse to latex.
5. Obtain height and weight of patient before treatment.	5. Obtaining height and weight helps verify accurate dosing.
6. Assess baseline vital signs before, during, and after treatment.	6. An elevated temperature at the beginning of treatment may be an indication to delay the therapy to avoid misinterpreting this as an adverse reaction.
7. Premedicate with acetaminophen/paracetamol (Tylenol) and diphenhydramine (Benadryl) as prescribed 30 minutes before the start of infusion therapy. Corticosteroids may be prescribed as well.	7. Premedicating may help avert adverse reactions. Corticosteroids may be used to prevent possible severe reactions in patients who are perceived to be at risk.
8. Verify the route and dose of IVIG therapy.	8. IVIG can be administered via the IV or SC routes. The optimal dose is determined by the patient's response. In most instances, an IV dose of 200–800 mg/kg of body weight is administered every 3–4 weeks to ensure adequate serum levels of immunoglobulin G (IgG).
9. Insert IV cannula or catheter according to Guidelines for Starting a Peripheral Intravenous Infusion, as needed.	9. Patient may need IV access, may have a port or long-term catheter for an IV infusion.
10. Administer the IV infusion at a slow rate, not to exceed 3 mL/min, usually at 100–200 mL/h.	10. Administer according to manufacturer's instructions. Beginning at a slow rate helps minimize adverse reactions.
11. Continually assess the patient for adverse reactions.	11. Be aware of complaints of a tickle or lump in the throat as the precursor to laryngospasm that precedes bronchoconstriction. Caution should be exercised when changing IVIG products, because they are not biologically equivalent. Understand that long-term tolerance of an older IVIG product does not necessarily imply tolerance to a newer product, even if it is technically superior.
12. Stop IV infusion at the first sign of reaction.	12. Initiate the institutional protocol to be followed in an emergent situation. Patients who have an IgA deficiency have IgE antibodies to IgA, which requires administration of plasma or immunoglobulin replacement from IgA-deficient patients. Because all IV immunoglobulin preparations contain some IgA, they may cause an anaphylactic reaction in patients with IgE anti-IgA antibodies.
13. Administer SC immunoglobulin as orders.	13. The pharmacokinetics of IgG differ when smaller doses are given more frequently, as is commonly done with SC regimens.

Adapted from Cherin, P., Marie, I., Michallet, M., et al. (2016). Management of adverse events in the treatment of patients with immunoglobulin therapy: A review of evidence. Autoimmunity Reviews, 15, 71–81.

Chart 55-1 HOME CARE CHECKLIST

Home Administration of Ig Replacement Therapy

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of immune deficiency on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State what types of changes are needed (if any) to maintain a clean home environment and prevent infection.
- State how to contact the primary provider, the team of home care professionals overseeing care, and intravenous supply vendor.
- State how to obtain medical supplies and carry out dressing changes, IV access site care, and other prescribed regimens.
- Identify the benefits and expected outcome of regular Ig replacement therapy.
- State rationale for prophylactic use of acetaminophen/paracetamol (Tylenol) and diphenhydramine (Benadryl) before treatment begins.
- State the rationale for prehydration on the day before infusion.
- Demonstrate how to prepare regular Ig replacement therapy.
- Demonstrate how to administer regular Ig replacement therapy.
- Demonstrate how to clean and maintain IV equipment, as applicable.
- Identify side effects and adverse effects of regular Ig replacement therapy.
- Demonstrate how to monitor for adverse effects of regular Ig replacement therapy.
- Describe to whom, how, and when to report adverse effects of regular Ig replacement therapy.
- Describe appropriate actions to take for adverse effects.
- Verbalize understanding of emergency measures for anaphylactic shock.

ADL, activities of daily living; IADL, independent activities of daily living.

in improving the length and quality of life for people living with HIV disease. During the first decade, progress was associated with the recognition and treatment of opportunistic diseases and introduction of prophylaxis against **opportunistic infections** (illnesses caused by various organisms, some of which usually do not cause disease in people with normal immune systems). The second decade witnessed progress in the development of highly active antiretroviral drug therapies (HAART) as well as continuing progress in the treatment of opportunistic infections. The third decade has focused on issues of preventing new infections, adherence to antiretroviral therapy (ART), development of second-generation combination medications that affect different stages of the viral life cycle, and continued need for an effective vaccine. The HIV antibody test, an **enzyme immunoassay** (**EIA**; or a variant of this test called *enzyme-linked immunosorbent assay* [ELISA]), became available in 1984, allowing early diagnosis of the infection before the onset of symptoms. Since then, HIV infection has been best managed as a chronic disease, most appropriately in an outpatient care setting, whereas AIDS may involve acute conditions that require hospitalization.

AIDS is defined as the occurrence of life-threatening opportunistic infections, malignancies, neurologic diseases, and other specific illnesses that occur in patients with HIV infection with a CD4 count <200 cells/mm^3 (NACO, 2021).

Epidemiology

Criteria for a confirmed case of HIV infection can be met by laboratory evidence along with clinical evidence but laboratory evidence is mandatory (e.g., patient signs and symptoms). A case of HIV infection can be classified in one of five HIV infection stages (0, 1, 2, 3, or unknown). Stage 0 indicates early HIV infection, inferred from laboratory testing; stages 1, 2, and 3 are based on the CD4$^+$ T-lymphocyte count; while cases with no information on CD4$^+$ T-lymphocyte count or percentage are classified as stage unknown (Selik, Mokotoff, Branson, et al., 2014). See Table 55-2 for further explanation of stages.

In light of intensive efforts globally, the HIV pandemic has been addressed but the burden remains significant. According to the World Health Organization (WHO) (2015a), there were approximately 36.9 million people living with HIV at the end of 2014 with 2.0 million people becoming newly infected with HIV in 2014 globally. Sub-Saharan Africa is the most affected region, with 25.8 million people living with HIV in 2014 and almost 70% of the global total of new HIV infections. About 51% of people with HIV know that they are infected; 40% of those needing ART are accessing treatment globally. Forty-seven percent of adults living with HIV/AIDS are female (17.4 million) (WHO, 2015b), many of whom are in their child-bearing years. The diagnosis and treatment of HIV infection remain highly dependent upon the geographic location of where the person is living.

Magnitude of Problem in India

The recent epidemiological data by the National AIDS Control Association (NACO, 2020) showed that the prevalence rate of AIDS was 0.22% among adult population aged 15 to 49 with an estimated 0.23% prevalence among males and 0.20% among females of the same age group. In the last 10 years, there has been a 33.3% decline in the AIDS prevalence among adults. The North East states of Mizoram and Nagaland secured the top two spots with a prevalence rate of 2.37% and 1.44%, respectively. The lowest prevalence was recorded in the state of Jammu and Kashmir (0.06%). As per the statistical data available in 2020, the total number of people living with HIV (PLHIV) was 23.19 lakhs (NACO, 2020). The national PLHIV rate was estimated to be 1721 per 1 million population. Mizoram had the highest rate of PLHIV with 17,207 per million population, while in Nagaland, the rate of PLHIV was 10,421 per million. The incidence rate of HIV in India was 0.04/1000 uninfected population in the year 2020 (NACO, 2020). The new HIV infection has shown a decline of 89% from the peak seen in 1997. The new HIV infection was estimated to be around 57,550 in the year 2020 (National Guidelines for HIV Care and Treatment, 2021).

HIV Transmission

Inflammation and breaks in the skin or mucosa result in the increased probability that an HIV exposure will lead to infection. Human immune deficiency virus type 1 (HIV-1) is transmitted in body fluids (blood, seminal fluid, vaginal secretions, amniotic fluid, and breast milk) that contain infected cells. Higher amounts of HIV and infected cells in the body fluid are associated with

TABLE 55-2 HIV Infection Stages 1, 2, and 3 Based on Age-Specific Laboratory Data

	Age on Date of CD4+ T-lymphocyte Test					
	<1 year		1–5 years		≥6 years	
Stage	Cells/IL	%	Cells/IL	%	Cells/IL	%
1	≥1,500	≥34	≥1,000	≥30	≥500	≥26
2	750–1,499	26–33	500–999	22–29	200–499	14–25
3	<750	<26	<500	<22	<200	<14

If a stage-3-defining opportunistic illness has been diagnosed, then the stage is 3 regardless of CD4+ T-lymphocyte test.

Stage-3-Defining Opportunistic Illnesses in HIV Infection

Bacterial infections, multiple or recurrent (only among children aged less than 6 years)
Candidiasis of bronchi, trachea, or lungs
Candidiasis of esophagus
Cervical cancer, invasive (only in persons aged 6 years or older)
Coccidioidomycosis, disseminated or extrapulmonary
Cryptococcosis, extrapulmonary
Cryptosporidiosis, chronic intestinal (>1 month's duration)
Cytomegalovirus disease (other than liver, spleen, or nodes), onset at age >1 month
Cytomegalovirus retinitis (with loss of vision)
Encephalopathy attributed to HIV
Herpes simplex: chronic ulcers (>1 month's duration) or bronchitis, pneumonitis, or esophagitis (onset at age >1 month)
Histoplasmosis, disseminated or extrapulmonary Isosporiasis, chronic intestinal (>1 month's duration)
Kaposi sarcoma
Lymphoma, Burkitt (or equivalent term)
Lymphoma, immunoblastic (or equivalent term)
Lymphoma, primary, of brain
Mycobacterium avium complex or *Mycobacterium kansasii,* disseminated or extrapulmonary
Mycobacterium tuberculosis of any site, pulmonary (only in persons aged 6 years or older) disseminated, or extrapulmonary
Mycobacterium, other species or unidentified species, disseminated or extrapulmonary
Pneumocystis jirovecii (previously known as "*Pneumocystis carinii*") pneumonia (PCP)
Pneumonia, recurrent (only in persons aged 6 years or older)
Progressive multifocal leukoencephalopathy
Salmonella septicemia (recurrent)
Toxoplasmosis of brain, onset at age >1 month
Wasting syndrome attributed to HIV

Adapted from Selik, R., Mokotoff, E., Branson, B., et al. (2014). Revised surveillance case definition for HIV infection—United States, 2014. Morbidity and Mortality Weekly Report, 63(RR03), 1–10.

the probability that the exposure will result in infection. Mother-to-child transmission of HIV-1 may occur in utero, at the time of delivery, or through breast-feeding, but most perinatal infections are thought to occur after exposure during delivery. HIV is not transmitted through casual contact (see Chart 55-2).

Blood and blood products can transmit HIV to recipients. However, the risk associated with transfusions has been virtually eliminated as a result of voluntary self-deferral, completion of a detailed health history, extensive testing, heat treatment of clotting factor concentrates, and more effective virus inactivation methods. Donated blood is tested for antibodies to HIV-1, human immunodeficiency virus type 2 ([retrovirus identified in 1986 in patients with AIDS in Western Africa]), and the p24 antigen; since 1999, additional testing has been performed.

Chart 55-2 RISK FACTORS

Risks Associated with HIV Infection

- Sharing infected injection drug use equipment
- Having sexual relations with infected individuals (both male and female)
- Infants born to mothers with HIV infection and/or who are breast-fed by HIV-infected mothers
- People who received organ transplants, HIV-infected blood, or blood products (especially between 1978 and 1985)

Gerontologic Considerations

A growing number of adults aged 50 and older have HIV/AIDS (National Institute on Aging [NIA], 2015). Many were diagnosed with HIV in their younger years and are benefitting from effective treatment. However, thousands of older adults unknowingly become infected with HIV every year. Older adults are less likely than younger people to get tested. Signs of HIV/AIDS can be mistaken for the aches and pains of normal aging. Older adults might be coping with other diseases common to aging that can mask the signs of HIV/AIDS.

Tillman and Mark (2015) examined published research on the frequency of HIV and sexually transmitted infection (STI)

testing among older adults (aged 50 and older), factors related to HIV and STI testing among older adults, and the perspectives and practices of older adults and health care providers related to patient-provider communication regarding sexual health. They found that low rates of HIV and STI testing were influenced by low perceived risk of infection by older adults and their health care providers. Providers bring societal age and gender biases to their perceptions of patient sexuality, which influence their communication about sexual health with older adult patients. Providers' assumptions that discussions about sexual health will offend their patients, as well as their own discomfort with talking to older adults about sex, inhibit them from assessing risk factors that may indicate a need for HIV and STI testing. Older adults living with HIV/AIDS also experience the development of other comorbidities such as cardiovascular disease and diabetes occurring within that specific demographic population, and HIV/AIDS becomes a contributing, but not necessarily primary, cause of mortality.

Prevention of HIV Infection

Nurses need to help in efforts to prevent HIV infection by educating how to eliminate or reduce risks associated with HIV infection and AIDS. HIV is transmitted through the exchange of some infected body fluids (see Chart 55-2). While behavioral interventions such as encouraging the use of condoms are highly effective in reducing the transmission of HIV, the HIV-negative person must be motivated and have the freedom to choose to use the method. In some situations, however, that freedom is absent. For example, a lack of freedom exists in a discordant couple (those in which only one partner has HIV) if the husband refuses to use condoms and the wife's cultural and religious beliefs require intercourse with her husband. In this context, pre-exposure prophylaxis (PrEP) might be appropriate. PrEP involves taking one pill containing two HIV medications (tenofovir disoproxil fumarate 300 mg and emtricitabine 200 mg [Truvada]) daily in order to avoid the risk of sexual HIV acquisition in adults and adolescents age 12 and older (Comerford, 2015). HIV status should be checked every 3 months to be sure that the person has not become infected. The ultimate goal of PrEP is to reduce the acquisition of HIV infection with its resulting morbidity, mortality, and cost to individuals and society (US Public Health Service, 2014).

Preventive Education

Prevention of HIV infection is achieved through: (a) behavioral interventions have been effective in reducing the risk of acquiring or transmitting HIV by ensuring that people have the information, motivation, and skills necessary to reduce their risk; (b) HIV testing, because most people change behaviors to protect their partners if they know they are infected with HIV; and (c) linkage to treatment and care, which enables individuals with HIV to live longer, healthier lives and reduce their risk of transmitting HIV (CDC, 2015c). The CDC (2014a), through the HIV/AIDS Prevention Research Synthesis Project, provides information about evidence-based behavioral interventions that can be used in a number of settings with targeted populations. Strategies to protect against infection are outlined in Chart 55-3. Other than abstinence, consistent and correct use of condoms (see Chart 55-4) is the only effective method to decrease the risk of sexual transmission of HIV infection. When latex male condoms are used consistently and correctly during vaginal or anal intercourse, they are highly effective in preventing the sexual transmission of HIV (CDC, 2013). Nonlatex condoms made of natural materials such as lambskin are available for people with latex allergy but will not protect against HIV infection. A male condom should be used for oral contact with the penis, and a dental dam (a flat piece of latex used by dentists to isolate a tooth for treatment) or an altered condom can be used for oral contact with the vagina or rectum. Medical male circumcision, when safely provided by well-trained health professionals, reduces the risk of heterosexually acquired HIV infection in men by approximately 60%. This is a key intervention in generalized epidemic settings with high HIV prevalence and a low male circumcision rate (WHO, 2015a).

The polyurethane female condom, which is an effective contraceptive, provides a physical barrier that prevents exposure to genital secretions containing HIV, such as semen and vaginal fluid, and is inserted by the woman. Other safe and effective woman-controlled methods such as microbicides remain elusive although clinical trials continue globally. Microbicides are gels, films, or *suppositories* that can kill or neutralize viruses and bacteria; *vaginal* and *rectal* microbicides are being researched to see if they can prevent sexual transmission of HIV.

Total abstinence from addictive drugs might not be a realistic short-term goal. Using a harm reduction framework, the nurse works with people who inject drugs to assist them to increase their healthy behaviors. Harm reduction frameworks use practical strategies and ideas aimed at reducing negative consequences associated with drug use and a movement for social justice built on a belief in, and respect for, the rights of people who use drugs. Therefore, under this framework,

Chart 55-3 HEALTH PROMOTION

Protecting Against HIV Infection

All patients should be advised to:

- Abstain from exchanging sexual fluids (semen and vaginal fluid).
- Reduce the number of sexual partners to one.
- Always use latex condoms. If the patient is allergic to latex, nonlatex condoms should be used; however, they will not protect against HIV infection.
- Not reuse condoms.
- Avoid using cervical caps or diaphragms without using a condom as well.
- Always use dental dams for oral–genital or anal stimulation.
- Avoid anal intercourse, because this practice may injure tissues; if not possible, use lubricant—there are water and silicone-based products designed for anal sex.
- Avoid manual–anal intercourse ("fisting").
- Avoid sharing needles, razors, toothbrushes, sex toys, or blood-contaminated articles.
- Consider PrEP if regularly engage in high-risk behaviors.

Patients who are HIV seropositive should also be advised to:

- Take ART regularly to achieve viral suppression.
- Inform previous, present, and prospective sexual and drug-using partners of their HIV-positive status. If the patient is concerned for their safety, advise the patient that many states have established mechanisms through the public health department in which professionals are available to notify exposed contacts.
- Avoid having unprotected sex with another HIV-seropositive person. Cross-infection with that person's HIV can increase the severity of infection.
- Not donate blood, plasma, body organs, or sperm.

ART, antiretroviral therapy; PrEP, pre-exposure prophylaxis.

Chart 55-4 PATIENT EDUCATION

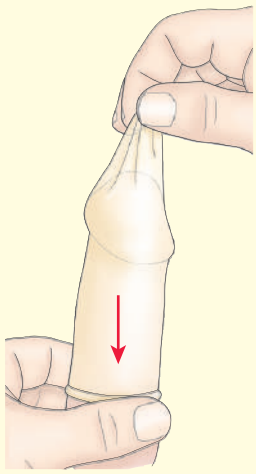
The Correct Way to Use a Male Condom

The nurse instructs the patient to:

1. Put on a new condom before any kind of sex.
2. Hold the condom by the tip to squeeze out the air.



3. Unroll the condom all the way over the erect penis.



4. Have sex.
5. Hold the condom so it cannot come off the penis.
6. Pull out.
7. Use a new condom if you want to have sex again or if you want to have sex in a different place (e.g., in the anus and then in the vagina).
8. *Note:* Keep condoms cool and dry. Never use skin lotions, baby oil, petroleum jelly, or cold cream as lubricants; the oil in these products will cause the latex condom to break. Products made with water (such as K-Y jelly or glycerin) are safer to use.

needle exchange programs are usually free and do not promote increased drug use; on the contrary, they have been found to decrease the incidence of blood-borne infections in people who inject drugs. Nurses should refer clients to needle exchange programs in their neighborhood whenever available. If new needles and syringes are not available, cleaning used needles and syringes with bleach may reduce the risk of HIV (CDC, 2015d). Sharing of drug-use equipment is a high-risk behavior for a number of blood-borne infections and should be avoided.

Related Reproductive Education

Because HIV infection in women often occurs during the child-bearing years, family planning issues need to be addressed. Attempts to achieve pregnancy by couples in which only one partner has HIV (known as discordant couples) expose the unaffected partner to the virus. Efforts at artificial insemination using processed semen from an HIV-infected partner continue. Studies are needed, because HIV has been found in the spermatozoa of patients with HIV infection, and it is possible that HIV can replicate in the male germ cell. Women considering pregnancy need to have accurate information about the risks of transmitting HIV infection to themselves, their partner, and their future children, and about the benefits of taking ART to reduce perinatal HIV transmission. Women in resource-rich settings who are HIV positive should be instructed not to breast-feed their infants, because HIV is transmitted through breast milk.

An increased risk of HIV infection in women is associated with hormonal contraceptive use, but a cause-and-effect relationship has not been established (Sharma & Walmsley, 2015). Women who are HIV negative and who use hormonal contraceptives to prevent pregnancy should be encouraged to use methods to block HIV infection including PrEP; providers should explore drug–drug interactions between hormonal contraceptives and ART in women infected with HIV (Sharma & Walmsley, 2015).

Prevention in Lesbian, Gay, Bisexual, and Transgender

Many health care providers are insufficiently prepared to meet the unique health needs of those who identify as lesbian, gay, bisexual, and transgender (LGBT). LGBT youth, in particular, are at higher risk for contracting HIV (Bosse, Nesteby, & Randall, 2015); (Johnson & Amella, 2013). At the same time, this population experiences significant challenges due to family rejection, lack of social support, stigma, isolation, minority stress, as well as abuse and harassment (Bosse, Nesteby, & Randall, 2015); (Johnson & Amella, 2013). Nurses need to be nonjudgmental in order to be effective in educating this population about prevention methods.

Reducing the Risk of Transmission to Health Care Providers

Standard Precautions

Implementation of appropriate hand hygiene measures (see Chart 1-4 for further information on hand hygiene methods) remains the most effective measure to prevent transmission of organisms. To reduce the risk of exposure of health care workers to HIV, the CDC developed standard precautions (see Chart 55-5) which are designed to reduce the risk of transmission of pathogens. Standard precautions are used when working with all patients in all health care settings, regardless of their diagnosis or presumed infectious status.

Post-Exposure Prophylaxis for Health Care Providers

Post-exposure prophylaxis (PEP) includes taking antiretroviral medicines as soon as possible, but no more than 72 hours (3 days) after possible HIV exposure; two to three drugs are usually prescribed which must be taken for 28 days.

Health care workers who are exposed to a needle stick involving HIV-infected blood in a health care setting have a 0.23% risk of becoming HIV infected; the risk of infection due to occupational exposure is very low. A tertiary care center reported occupational exposure of 105 healthcare workers to blood and body fluids. 85% of the exposure was due to

Chart 55-5

Recommendations for Standard Precautions

1. **Hand hygiene**: Use after touching blood, body fluids, secretions, excretions, or contaminated items; immediately after removing gloves; and between patient contacts.
2. **Personal protective equipment**:
   - *Gloves:* Use for touching blood, body fluids, secretions, excretions, and contaminated items, and for touching mucous membranes and nonintact skin.
   - *Gown:* Use during procedures and patient care activities when contact of clothing/exposed skin with blood or body fluids, secretions, and excretions is anticipated.
   - *Mask, eye protection (goggles), face shield*[1]: Use during procedures and patient care activities likely to generate splashes or sprays of blood, body fluids, and secretions, especially suctioning or endotracheal intubation.
3. **Soiled patient care equipment**: Handle in a manner that prevents transfer of microorganisms to others and to the environment; wear gloves if visibly contaminated; and perform hand hygiene.
4. **Environmental control**: Develop procedures for routine care, cleaning, and disinfection of environmental surfaces, especially frequently touched surfaces in patient care areas.
5. **Textiles and laundry**: Handle in a manner that prevents transfer of microorganisms to others and to the environment.
6. **Needles and other sharps**: Do not recap, bend, break, or hand manipulate used needles; if recapping is required, use a one-handed scoop technique only; use safety features when available; and place used sharps in a puncture-resistant container.
7. **Patient resuscitation**: Use mouthpiece, resuscitation bag, and other ventilation devices to prevent contact with mouth and oral secretions.
8. **Patient placement**: Prioritize for single-patient room if patient is at increased risk for transmission, is likely to contaminate the environment, does not maintain appropriate hygiene, or is at increased risk for acquiring infection or developing adverse outcome following infection.
9. **Respiratory hygiene/cough etiquette** (source containment of infectious respiratory secretions in symptomatic patients, beginning at initial point of encounter, such as triage and reception areas in emergency departments and physician offices): Instruct symptomatic people to cover mouth and nose when sneezing or coughing, use tissues and dispose in no-touch receptacle, observe hand hygiene after soiling of hands with respiratory secretions, and wear surgical mask if tolerated.

From Centers for Disease Control and Prevention (CDC). (2007). 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Retrieved on 5/13/2016 at: www.cdc.gov/hicpac/2007ip/2007ip_part1.html

[1]During aerosol-generating procedures on patients with suspected or proven infections transmitted by respiratory aerosols (e.g., severe acute respiratory syndrome), wear a fit-tested N95 or higher respirator in addition to gloves, gown, and face/eye protection.

needle stick injuries. 16 of them were exposed to body fluids of HIV-positive people (Priya, Krishnan, Jayalakshmi, et al., 2015). Occupational exposure is considered an urgent medical concern and should be managed immediately after possible exposure—the sooner the better; every hour counts (CDC, 2015e). The CDC is suggesting that these post-exposure guidelines be followed after occupational and other exposures such as sexual assault. Chart 55-6 provides the strategies and emphasizes the need for quick action.

Chart 55-6

Post-HIV Exposure Prophylaxis for Health Care Providers

If you sustain an occupational exposure to HIV, take the following actions immediately:

- Alert your supervisor and initiate the occupational exposure reporting system used in the setting.
- Determine the HIV status of the exposure source (i.e., patient) when possible to guide appropriate use of HIV post-exposure prophylaxis (PEP). Use rapid-testing if the HIV status of the patient is unknown. Get counseling at the time of exposure and at follow-up appointments
- The Govt of India/concerned health agency is supplying the ARV drugs.
- Exposed health care providers (HCP) are advised to use precautions (e.g., use of barrier contraception and avoidance of blood or tissue donations, pregnancy, and, if possible, breast-feeding) to prevent secondary transmission, especially during the first 6–12 weeks after exposure.
- For exposures for which three drug PEP is prescribed, HCPs are informed regarding the following:
  - Possible drug toxicities (e.g., rash and hypersensitivity reactions that could imitate acute HIV seroconversion and the need for monitoring)
  - Possible drug interactions
  - The need for adherence to PEP regimens

Undergo early reevaluation after exposure:

- Regardless of whether an HCP is taking PEP, reevaluation of exposed HCP within 72 hours after exposure is strongly recommended, as additional information about the exposure or the source patient may be available.

Follow-up with HIV testing and appointments. At a minimum, this follow-up should include:

- HIV testing at baseline and at 6 weeks, 12 weeks, and 6 months after exposure; alternatively, if the HCP is certain that a fourth-generation combination HIV p24 antigen–HIV antibody test is being utilized, then HIV testing could be performed at baseline, 6 weeks after exposure, and 4 months after exposure
- Complete blood counts and renal and hepatic function tests (at baseline and 2 weeks after exposure; further testing may be indicated if abnormalities are detected)

Note: All HIV testing results should preferably be given to the exposed HCP during face-to-face appointments.

Adapted from Kuhar, D., Henderson, D., Struble, K., et al. (2013). Updated US Public Health Service guidelines for the management of occupational exposures to human immunodeficiency virus and recommendations for post-exposure prophylaxis. Infection Control and Hospital Epidemiology, 34(9), 875–892.

Vaccination

In the face of a global pandemic, the search for an effective vaccine against the HIV remains an urgent priority (Fauci & Marston, 2015). The first U.S. government-sponsored phase I trial of an HIV vaccine was launched in 1987 and intensive efforts worldwide using a variety of strategies continue.

Pathophysiology

Because HIV is an infectious disease, it is important to understand how HIV-1 integrates itself into a person's immune system and how the immune response plays a pivotal role in the course of HIV disease. This knowledge is also essential for understanding medication therapy and vaccine development. Viruses are intracellular parasites. HIV is in the subfamily of

lentiviruses and is a retrovirus because it carries its genetic material in the form of ribonucleic acid (RNA) rather than deoxyribonucleic acid (DNA) (Grossman & Porth, 2014).

Two genetically different but closely related forms of HIV (HIV-1 and HIV-2) have been identified. The course of illness is slower when infection is caused by HIV-2, which seems to be more common in Western Africa compared to HIV-1, which is more common in other regions of the globe. Blood tests may be used to screen for both forms of HIV. As shown in Figure 55-1A, HIV consists of a viral core containing viral RNA, surrounded by an envelope consisting of protruding glycoproteins.

All viruses target specific cells. HIV targets cells with $CD4^+$ receptors, which are expressed on the surface of T lymphocytes, monocytes, dendritic cells, and brain microglia. Mature T cells (T lymphocytes) are composed of two major subpopulations that are defined by cell surface receptors of $CD4^+$ or $CD8^+$. Approximately two thirds of peripheral blood T cells are $CD4^+$, and approximately one third are $CD8^+$. Most people have about 700 to 1,000 $CD4^+$ cells/mm^3, but a level as low as 500 cells/mm^3 can be considered within normal limits. During stage 0, which is also known as acute/recent infection, most varieties of HIV-1 use the chemokine cell receptor molecule CCR5 (R5 virus) for entry to T cells in addition to the $CD4^+$ receptor, which suggests that the R5 variant is preferred to a different variant (CXCR4) but the preferred coreceptor can shift over the course of infection.

The HIV life cycle is complex (see Fig. 55-1B) and consists of the following steps (Grossman & Porth, 2014):

1. **Attachment/Binding:** In this first step, the GP120 and GP41 glycoproteins of HIV bind with the host's uninfected $CD4^+$ receptor and chemokine coreceptors, usually CCR5, which results in fusion of HIV with the $CD4^+$ T-cell membrane.
2. **Uncoating/Fusion:** Only the contents of HIV's viral core (two single strands of viral RNA and three viral enzymes: reverse transcriptase, integrase, and protease) are emptied into the $CD4^+$ T cell.

Physiology/Pathophysiology

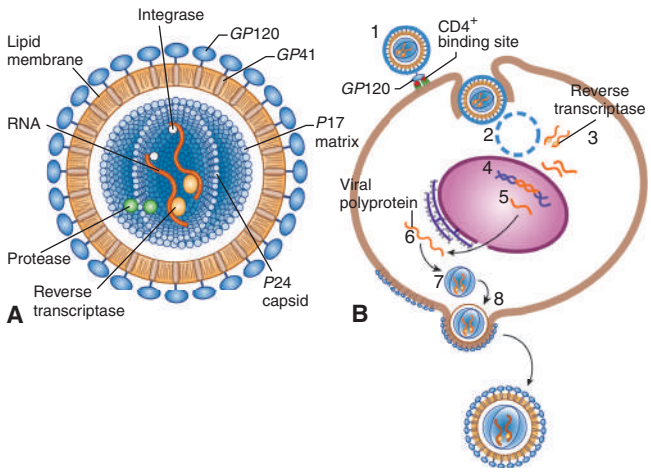


Figure 55-1 • **A**. Structure of HIV-1 virus. The virus surrounded by a lipid envelope. **B**. Life cycle of HIV-1. Reprinted with permission from Grossman, S., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

3. **DNA synthesis:** HIV changes its genetic material from RNA to DNA through action of reverse transcriptase, resulting in double-stranded DNA that carries instruction for viral replication.
4. **Integration:** New viral DNA enters the nucleus of the $CD4^+$ T cell and through action of integrase is blended with the DNA of the $CD4^+$ T cell, resulting in permanent, lifelong infection. Prior to this, the uninfected person has been only exposed to, not infected with, HIV. With this step, HIV infection is permanent.
5. **Transcription:** When the $CD4^+$ T cell is activated, the double-stranded DNA forms single-stranded messenger RNA (mRNA), which builds new viruses.
6. **Translation:** The mRNA creates chains of new proteins and enzymes (polyproteins) that contain the components needed in the construction of new viruses.
7. **Cleavage:** The HIV protease enzyme cuts the polyprotein chain into the individual proteins that make up the new virus.
8. **Budding:** New proteins and viral RNA migrate to the membrane of the infected $CD4^+$ T cell, exit from the cell, and start the process all over.

In resting (nondividing) $CD4^+$ cells, HIV survives in a latent state as an integrated **provirus** that produces few or no viral particles. These resting $CD4^+$ T cells can be stimulated to produce new particles if something activates them, such as another infection. When a resting T cell that harbors this integrated DNA (also known as provirus) becomes activated against HIV or other microbes, the cell begins to produce new copies of both RNA and viral proteins. Consequently, whenever the infected $CD4^+$ cell is activated, HIV replication and budding occur, which can destroy the host cell. Newly formed HIV released into the blood can infect other $CD4^+$ cells.

A mutation of CCR5 that is common in Caucasians, but not other ethnic groups, has been identified. About 1% of Caucasians lack functional CCR5 and are highly protected against HIV infection even if exposed (although protection is not absolute); about 18% are not markedly protected against infection but, if infected, demonstrate significantly slower rates of disease progression. CCR5 levels on T cells influence HIV acquisition, disease progression rates, viral load, and immune recovery during ART (Gornalusse, Mummidi, Gaitan, et al., 2015).

HIV-1 mutates quickly, at a relatively constant rate, with about 1% of the virus's genetic material changing annually. HIV-1 exhibits substantial genetic diversity, and several different genotypes of HIV-1 exist throughout the world. There is a major group (group M), which consists of subtypes A through L, and a more diverse collection of outliers, which has been referred to as groups N and O. Subtype B HIV-1 viruses predominate in the Western world; this genetic variation is one of the major reasons why effective vaccine development has been such a challenge.

Stages of HIV Infection

There are five stages of HIV infection based on clinical history, physical examination, laboratory evidence (Selik et al., 2014), signs and symptoms, and associated infections and malignancies. See Table 55-2.

The period from infection with HIV to the development of HIV-specific antibodies is known as **primary infection or acute HIV infection** (previously known as the window period) and is part of stage 0 (Selik et al., 2014). Acute HIV infection is the

interval between the appearance of detectable HIV RNA and the first detection of antibodies. Its duration also depends on the design of the antibody immunoassay and the sensitivity of the immunoassay during seroconversion (CDC, 2014b). Initially, there is a period during which those who are HIV positive test negative on the HIV antibody blood test, although they are infected and highly infectious, because their viral loads are very high. About 40% to 80% of patients develop clinical symptoms of a nonspecific viral illness (e.g., fever, fatigue, or rash) lasting 1 to 2 weeks. After 2 to 3 weeks, antibodies to the glycoproteins of the HIV envelope can be detected in the sera of people infected with HIV, but most of these antibodies lack the ability to totally control the virus. By the time neutralizing antibodies can be detected (stage 1), HIV-1 is firmly established in the host.

Primary or acute infection is characterized by high levels of viral replication, widespread dissemination of HIV throughout the body, and destruction of $CD4^+$ T cells, which leads to dramatic drops in $CD4^+$ T-cell counts (normally 500 to 1,500 cells/mm^3 of blood). The host responds to the HIV infection through a $CD4^+$ T-cell response that causes other immune cells, such as $CD8^+$ lymphocytes, to increase their killing of infected, virus-producing cells. The body produces antibody molecules in an effort to contain the free HIV particles (outside cells) and assist in their removal. During this stage, the virus is widely disseminated in lymphoid tissue, and a latent reservoir within resting memory $CD4^+$ T cells is created.

The amount of virus in the body after the initial immune response subsides is referred to as the viral set point, which results in an equilibrium between HIV levels and the immune response that may be elicited. This can last for years and is inversely correlated with disease prognosis. The higher the viral set point, the poorer the prognosis. After the viral set point is reached, a chronic stage persists in which the immune system cannot eliminate the virus despite its best efforts. This set point varies greatly from patient to patient and dictates the subsequent rate of disease progression; on average, 8 to 10 years can pass before a major HIV-related complication develops. In this prolonged, chronic stage, patients feel well and have few, if any, symptoms. Apparent good health continues because $CD4^+$ T-cell levels remain high enough to preserve immune defensive responses, but over time, the number of $CD4^+$ T cells continues to decrease.

Stage 2 occurs when $CD4^+$ T-lymphocyte cells are between 200 and 499, stage 3 when the count drops below 200 cells/mm^3 of blood and at this point, the person is considered to have AIDS for surveillance purposes. HIV disease progression is classified from less to more severe; once a case is classified into a surveillance severity stage, it cannot be reclassified into a less severe stage even if the $CD4^+$ T-lymphocytes increase, which often occurs when a person receives ART. A stage 3 diagnosis has implications for services (e.g., disability benefits, housing, and food stamps), because these programs are often linked to living with severe immune dysfunction.

Assessment and Diagnostic Findings in HIV Infection

During the first stage of HIV infection, the patient may be asymptomatic or may exhibit various signs and symptoms such as fatigue or skin rash. Patients who are in later stages of HIV infection may have a variety of symptoms related to their immunosuppressed state. The staging system requires laboratory evidence of HIV infection in order to diagnose HIV or AIDS (see Table 55-2).

HIV Tests

Several screening tests are used to diagnose HIV infection, and others are used to determine the stage and severity of the infection. A serologic testing algorithm for recent HIV seroconversion (STARHS) analyzes HIV-positive blood samples to determine whether an HIV infection is recent or has been ongoing. As per NACO guidelines, all pregnant ladies are tested for HIV in India. There are three types of HIV diagnostic tests: antibody tests, antigen/antibody tests, and nucleic acid (RNA) tests. Antibody tests detect antibodies, not HIV itself, while antigen and RNA tests directly detect HIV. The updated CDC recommendations (2014b) tests for HIV antigens and HIV nucleic acid because studies from populations at high risk for HIV demonstrated that antibody testing alone might miss a considerable percentage of HIV infections detectable by virologic tests, especially during stage 0.

Blood tests can detect HIV infection sooner after exposure than oral fluid tests because the level of antibody in blood is higher than it is in oral fluid. Likewise, antigen/antibody and RNA tests detect infection in blood before antibody tests. Some newer antigen/antibody laboratory tests can sometimes find HIV as soon as 3 weeks after exposure to the virus. No antigen/antibody or RNA tests are available for oral fluid.

Follow-up testing is performed if the initial test result is positive to ensure a correct diagnosis. These tests include (CDC, 2015f):

- antibody *differentiation test,* which distinguishes HIV-1 from antibodies
- *HIV-1 nucleic acid test,* which looks for the virus RNA directly

Table 55-3 identifies common blood tests used for screening.

Since negative perceptions and judgments associated with being HIV infected continue to persist, stigma remains one of the biggest social challenges (Chambers, Rueda, Baker, et al., 2015). When the result of the HIV antibody test is received, it is carefully explained to the patient in private (see Chart 55-7). All test results are confidential. Education and counseling about the test result and about preventing transmission are essential. The patient's psychological response to a positive test result may include feelings of panic, depression, and hopelessness. The social and interpersonal consequences of a positive test result can be devastating. The patient may lose their sexual partner, housing, and their job because of disclosure. He or she may be subjected to physical abuse and, although illegal, experience discrimination in employment as well as social ostracism. For these reasons and others, patients who test positive may need ongoing counseling as well as referrals for social, financial, medical, and psychological support services. They

TABLE 55-3 HIV Screening Blood Tests

Laboratory Test	Indications
HIV-1/HIV-2 immunoassay	Tests for both HIV-1 and HIV2 antibodies
HIV/1-HIV-2 antigen/antibody combination immunoassay	Tests for both antibody and virus for both HIV-1 and HIV-2
HIV-1 differentiation assay	Differentiates HIV-1 from HIV-2
HIV-1 nucleic acid amplification test	Tests directly for virus
HIV-1 p24 antigen	Tests directly for virus

HIV, human immune deficiency virus.

Adapted from Centers for Disease Control and Prevention. (2014b). Laboratory Testing for the Diagnosis of HIV Infection: Updated Recommendations. Available at: stacks.cdc.gov/view/cdc/23447. Published June 27, 2014.

Chart 55-7

HIV Test Results: Implications for Patients

Interpretation of Positive Test Results

- Antibodies to HIV are present in the blood (the patient has been infected with the virus, and the body has produced antibodies).
- HIV is active in the body, and the patient can transmit the virus to others.
- Despite HIV infection, the patient does not necessarily have AIDS.
- The patient is not immune to HIV (the antibodies do not indicate immunity).

Interpretation of Negative Test Results

- Antibodies to HIV are not present in the blood at this time, which can mean that the patient has not been infected with HIV or, if infected, the body has not yet produced antibodies (stage 0).
- The patient should continue taking precautions. The test result does not mean that the patient is immune to the virus, nor does it mean the patient is not infected; it just means that the body may not have produced antibodies yet. If viral test used, a negative result is more consistent with the conclusion that the patient is uninfected.

AIDS, acquired immune deficiency syndrome; HIV, human immune deficiency virus.

must be connected to health care services to evaluate their stage of HIV infection and develop the treatment plan. Patients whose test results are seronegative may develop a false sense of security, possibly resulting in continued high-risk behaviors or feelings that they are immune to the virus. These patients may need ongoing counseling to help modify high-risk behaviors and to encourage returns for repeated testing. Other patients may experience anxiety regarding the uncertainty of their status. In addition to screening for HIV, patients should be screened for other blood-borne infections such as hepatitis; other STIs such as syphilis; and other infections associated with T-cell immunity such as tuberculosis (TB).

Staging

Two surrogate markers are used routinely to assess immune function and level of HIV viremia: $CD4^+$ T-cell count ($CD4^+$ count) and plasma HIV RNA (viral load). $CD4^+$ count should be measured in all patients at entry into care. **Viral load tests** use target amplification methods to quantify HIV RNA or DNA levels in the plasma. Target amplification methods include reverse transcriptase–polymerase chain reaction (RT-PCR) and nucleic acid sequence–based amplification (NAT). A widely used viral load test measures plasma HIV RNA levels. Currently, these tests are used to track viral load and response to treatment of HIV infection. RT-PCR is also used to detect HIV in high-risk seronegative people before antibodies are measurable, to confirm a positive EIA result, and to screen neonates. HIV culture or quantitative plasma culture and plasma viremia are additional tests that measure viral burden, but they are used infrequently. Viral load is a better predictor of the risk of HIV disease progression than the $CD4^+$ count. The lower the viral load, the longer the time to AIDS diagnosis and the longer the survival time. The key goal of ART is to achieve and maintain durable viral suppression.

Treatment of HIV Infection

Antiretroviral treatment guidelines for HIV-infected adults and adolescents that have been recommended by NACO are followed across the country (ART guidelines, NACO, 2013). The $CD4^+$ count serves as the major laboratory indicator of immune function and prophylaxis for opportunistic infections, and is the strongest predictor of subsequent disease progression and survival New drugs that offer new mechanisms of action, improvements in potency and activity even against multidrug-resistant viruses, dosing convenience, and tolerability have been approved. The overarching goal of ART is to suppress HIV replication to a level below which drug-resistant mutations do not emerge; related goals are to (1) reduce HIV-associated morbidity and prolong the duration and quality of survival, (2) restore and preserve immunologic function, (3) maximally and durably suppress plasma HIV viral load, and (4) prevent HIV transmission (ART Guidelines, NACO, 2013). ART is now recommended for all HIV-infected patients regardless of their viral load or $CD4^+$ count (ART Guidelines, NACO, 2013). Optimal viral suppression is defined generally as a viral load persistently below the level of detection (HIV RNA less than 20 to 75 copies/mL, depending on the assay used). Clinicians, in partnership with patients, make treatment decisions based on a number of factors, including whether the patient has already taken ART or is ART-naive and the willingness of the patient to adhere to the lifelong treatment regimen.

Achieving viral suppression requires the use of ART with at least two, and preferably three, active drugs from two or more drug classes and should occur within the first 12 to 24 weeks of therapy especially if the patient is new to ART (Panel, 2016). More than 25 antiretroviral (ARV) drugs (see Table 55-4) in 6 classes are Food and Drug Administration (FDA) approved for the treatment of HIV infection. The different drug classes of ART target some of the steps in the HIV/host cycle (see Fig. 55-1). These six classes include the nucleoside/nucleotide reverse transcriptase inhibitors (step 3), non-nucleoside reverse transcriptase inhibitors (step 3), protease inhibitors (step 6), a fusion inhibitor (step 1), a CCR5 antagonist (step 1), and integrase strand transfer inhibitors (step 4). In addition, two drugs (cobicistat and ritonavir) are used to improve the pharmacokinetic profiles of some of the other ART drugs. Some pharmaceutical companies have combined two to three agents into one tablet or capsule. The Panel (2016) provides clear directions regarding which medications should be prescribed for both ART-naive and experienced patients.

Viral loads are often not suppressed because the patient is not adhering to the treatment plan. Psychosocial barriers such as depression and other mental illnesses, neurocognitive impairment, low health literacy, low levels of social support, stressful life events, high levels of alcohol consumption and active substance use, homelessness, poverty, nondisclosure of HIV serostatus, denial, stigma, and inconsistent access to medications affect adherence to ART. Failure to adopt practices that facilitate adherence, such as linking medication taking to daily activities or using a medication reminder system or a pill organizer, is also associated with treatment failure (Panel, 2016). Simplifying treatment regimens and decreasing the number of medications that must be taken each day increase patients' adherence to therapy. Although antiretroviral regimens have become less complex, side effects create barriers to adherence and inadequate dosing can lead to viral resistance. It is difficult to predict patients' adherence to medication regimens, but a positive relationship between the patient and health care provider is associated with better adherence. Individualized plans of care that consider housing and social support issues, in addition to health indicators including possible drug–drug

TABLE 55-4 Antiretroviral Agents[a]

Generic Name (Abbreviation) and Trade Names (Italic)	Food Interactions	Adverse Effects
Nucleoside Reverse Transcriptase Inhibitors (NRTIs)		
Abacavir (ABC) *Ziagen* *Trizivir* (ABC/ZDV/3TC) *Epzicom* (ABC/3TC) *Triumeq* (ABC/3TC/DTG)	Take without regard to meals.	Hypersensitivity reaction, which can be fatal; symptoms may include fever, rash, nausea, vomiting, diarrhea, abdominal pain, malaise or fatigue, loss of appetite, and respiratory symptoms such as sore throat, cough, shortness of breath.
Didanosine (ddl) *Videx* *EC*	Take half hour before or 2 hours after meals.	Pancreatitis, peripheral neuropathy, retinal changes, nausea, diarrhea, lactic acidosis with fatty degeneration of the liver, insulin resistance/diabetes.
Emtricitabine (FTC) *Emtriva*	Take without regard to meals.	Minimal toxicity, hyperpigmentation/skin discoloration. Severe acute exacerbation of hepatitis.
Atripla (FTC/EFV/TDF)	Take on empty stomach to reduce side effects.	Minimal toxicity, lactic acidosis with hepatic steatosis.
Complera (FTC/RPV/TDF)	Take with a snack.	Peripheral neuropathy, lipodystrophy, pancreatitis, lactic acidosis with hepatic steatosis (higher incidence with d4 T than with other NRTIs), hyperlipidemia, rapidly progressive ascending neuromuscular weakness (rare).
Stribild (FTC/EVG/c/TDF)	Take with a snack.	
Truvada (FTC/TDF)	Take without regard to meals.	
Lamivudine (3TC) *Epivir* *Combivir* (3TC/ZDV)	Take without regard to meals.	
Epzicom (3TC/ABC) *Trizivir* (ABC/3TC/ZDV)		
Stavudine (d4 T) *Zerit*		
Tenofovir disoproxil fumarate (TDF) *Viread*	Take without regard to meals.	Asthenia, headache, diarrhea, nausea, vomiting, and flatulence; kidney insufficiency; lactic acidosis with hepatic steatosis.
Zidovudine (AZT or ZDV) *Retrovir* *Combivir* (3TC/AZT) *Trizivir* (ABC/3TC/AZT)	Take without regard to meals.	Bone marrow suppression; macrocytic anemia or neutropenia; nail pigmentation, GI intolerance, headache, insomnia, asthenia; lactic acidosis with hepatic steatosis.
Non-Nucleoside Reverse Transcriptase Inhibitors		
Efavirenz (EFV) *Sustiva* *Atripla (EFV/TDF/FTC)*	Take on empty stomach.	Rash (rare cases of Stevens–Johnson syndrome have been reported), central nervous system symptoms (dizziness, somnolence, insomnia, abnormal dreams, confusion, abnormal thinking, impaired concentration, amnesia, agitation, depersonalization, hallucinations, and euphoria), increased transaminase levels, false-positive cannabinoid test, teratogenic in monkeys and potentially teratogenic in humans during first trimester of pregnancy.
Etravirine (ETR) *Intelence*	Take following a meal.	Rash, including Stevens–Johnsons syndrome, hypersensitivity reaction, nausea.
Nevirapine (NVP) *Viramune* *XR*	Take without regard to meals.	Rash including Stevens–Johnson syndrome, symptomatic hepatitis including fatal hepatic necrosis has been reported. Single dose has been used in developing countries to prevent vertical transmission.
Rilpivirine (RPV) *Edurant* *Complera (RPV/TDF/FTC)*	Take with a meal of between 400 and 600 calories.	Rash, depression, insomnia, headache, hepatotoxicity.
Protease Inhibitors		
Atazanavir (ATV) *Reyataz* *Evotaz (ATV/c)*	Take with a snack.	Indirect hyperbilirubinemia; prolonged PR interval (some patients experience asymptomatic first-degree AV block); EKG changes; hyperglycemia; fat maldistribution; possible increased bleeding episodes in patients with hemophilia. Check creatinine clearance.
Darunavir (DRV) *Prezista* *Prezcobix (DRV/c)*	Take with a snack.	Skin rash (10%), Stevens–Johnson syndrome, diarrhea, nausea, headache, cold-like symptoms (including runny nose or sore throat), inflammation of the liver, abnormal liver function tests, fever, and abnormally high cholesterol and triglyceride levels have been reported.
Fosamprenavir (FPV) *Lexiva*	Tablets may be taken with or without food.	Skin rash (19%), diarrhea, nausea, vomiting, headache, hyperlipidemia, transaminase elevation, hyperglycemia, fat maldistribution, possible increased bleeding episodes in patients with hemophilia.

(*Continued*)

(*Continued*)

Indinavir (IDV) *Crixivan*	For unboosted IDV: Should be taken 1 hour before or 2 hours after meals; may take with skim milk or low-fat meal. For RTV-boosted IDV: Can be taken with or without food.	Nephrolithiasis, GI intolerance, nausea, indirect hyperbilirubinemia, hyperlipidemia, headache, asthenia, blurred vision, dizziness, rash, metallic taste, thrombocytopenia, alopecia, hemolytic anemia, hyperglycemia, fat maldistribution, possible increased bleeding episodes in patients with hemophilia.
Lopinavir + ritonavir (LPV/r) *Kaletra*	Liquid forms are taken with a snack; no restrictions for tablet.	GI intolerance, nausea, vomiting, diarrhea, asthenia, hyperlipidemia (especially hypertriglyceridemia), elevated serum transaminase, hyperglycemia, fat maldistribution, possible increased bleeding episodes in patients with hemophilia, EKG changes.
Nelfinavir (NFV) *Viracept*	Take with a snack.	Diarrhea, hyperlipidemia, hyperglycemia, fat maldistribution, possible increased bleeding episodes in patients with hemophilia, serum transaminase elevation.
Ritonavir (RTV) *Norvir*	Take with a snack.	GI intolerance, nausea, vomiting, diarrhea, paresthesias (circumoral and extremities), hyperlipidemia (especially hypertriglyceridemia), hepatitis, asthenia, taste perversion, hyperglycemia, fat maldistribution, possible increased bleeding in patients with hemophilia. Lower doses used as a booster.
Saquinavir (SQV) *Invirase*	Take with meals or within 2 hours after meal.	GI intolerance, nausea, diarrhea, abdominal pain and dyspepsia, headache, hyperlipidemia, elevated transaminase enzymes, hyperglycemia, fat maldistribution, possible increased bleeding episodes in patients with hemophilia, EKG changes.
Tipranavir (TPV) *Aptivus*	Take with a snack.	Serious liver problems, bleeding on the brain, skin rash (21%), increased cholesterol and triglyceride levels, and changes in body fat; women taking birth control pills that contain estrogen may be more likely to develop a rash. Individuals with hemophilia may have increased bleeding. Take with RTV, if prescribed.
Fusion Inhibitor		
Enfuvirtide (T-20) *Fuzeon*	Injected subcutaneously, so meals are not an issue.	Local injection site reactions—almost 100% of patients (pain, erythema, induration, nodules and cysts, pruritus, ecchymosis); increased rate of bacterial pneumonia; hypersensitivity reaction—symptoms may include rash, fever, nausea, vomiting, chills, rigors, hypotension, or elevated serum transaminases.
Integrase Inhibitor (INSTIs)		
Dolutegravir (DTG) *Tivicay*	Take without regard to meals.	Hypersensitivity reaction including rash, constitutional symptoms, and organ dysfunction, insomnia, headache.
Elvitegravir (EVG)	Take with a snack.	Nausea, diarrhea.
Vitekta *Stribild (EVG/c/FTC/TDF)*	Take with a snack.	Nausea, diarrhea, renal impairment, decrease in bone density, acute exacerbation of hepatitis, lactic acidosis.
Raltegravir (RAL) *Isentress*	Take without regard to meals.	Rash including Stevens–Johnson syndrome, diarrhea, nausea, headache, fever, insomnia.
CCR5 Antagonist		
Maraviroc (MVC) *Selzentry*	Take without regard to meals; requires CCR5 tropism blood test before starting.	Cough, fever, dizziness, headache, orthostatic hypotension, nausea, bladder irritation; possible liver problems and cardiac events; an increased risk for some infections; a slight increase in cholesterol levels.

AV, atrioventricular; EKG, electrocardiogram; GI, gastrointestinal.

[a]This information changes often. Check the Panel and also the U.S. Food and Drug Administration website, http://www.fda.gov/forpatients/illness/hivaids/ucm118915.htm) for current information when using ART.

Adapted from Panel on Antiretroviral Guidelines for Adults and Adolescents (Panel). (2016). Guidelines for the use of antiretroviral agents in HIV-1-infected adults and adolescents. Department of Health and Human Services. Retrieved on 5/12/16 at: www.aidsinfo.nih.gov/ContentFiles/AdultandAdolescentGL.pdf. Appendix B, Tables 1 through 6.

interactions, are essential. Self-reported adherence measures can distinguish clinically meaningful patterns of medication-taking behaviors; therefore, nurses should assess if patients can describe how they are taking their ART.

Chart 55-8 summarizes strategies that health care providers can encourage to promote treatment regimen adherence. Every health care encounter should be used as an opportunity to briefly review the treatment regimen, identify any new issues, and reinforce successful behaviors.

Laboratory tests evaluate whether ART is effective for a specific patient. An adequate $CD4^+$ response for most patients on ART is an increase in $CD4^+$ count in the range of 50 to 150 mm^3 per year, generally with an accelerated response in the first 3 months (Panel, 2016). Viral load should be measured at baseline and on a regular basis thereafter because viral load is the most important indicator of response to ART.

Adverse effects associated with all HIV treatment regimens include hepatotoxicity, nephrotoxicity, and osteopenia, along with increased risk of cardiovascular disease and myocardial infarction (see Table 55-4). Many of the antiretroviral agents may cause fat redistribution syndrome and metabolic alterations such as dyslipidemia and insulin resistance, which put the patient at risk for early-onset heart disease and diabetes. The fat redistribution syndrome (lipodystrophy) consists of lipoatrophy (localized subcutaneous fat loss in the face, arms, legs, and buttocks) and lipohypertrophy (central visceral fat [lipomata] accumulation in the abdomen, although possibly in the breasts, dorsocervical region [buffalo hump], and within the

Chart 55-8

Promoting Adherence to ART

Strategies	Examples
Use a multidisciplinary team approach. Provide an accessible, trustworthy health care team.	• Nonjudgmental providers, nurses, social workers, pharmacists, and medication managers.
Strengthen early linkage to care and retention in care.	• Encourage health care team participation in linkage to and retention in care.
Assess patient readiness to start ART.	
Evaluate patient's knowledge about HIV disease, prevention and treatment and, on the basis of the assessment, provide HIV-related information.	• Consider the patient's current knowledge base, provide information about HIV, including the natural history of the disease, HIV viral load and $CD4^+$ count and expected clinical outcomes according to these parameters, and therapeutic and prevention consequences of nonadherence.
Identify facilitators, potential barriers to adherence, and necessary medication management skills before starting ART medication.	• Assess patient's cognitive competence and any impairment. • Assess behavioral and psychosocial challenges including depression, mental illnesses, levels of social support, high levels of alcohol consumption and active substance use, nondisclosure of HIV serostatus and stigma. • Identify and address language and literacy barriers. • Assess beliefs, perceptions, and expectations about taking ART (e.g., impact on health, side effects, disclosure issues, consequences of nonadherence). • Ask about medication taking skills and foreseeable challenges with adherence (e.g., past difficulty keeping appointments, adverse effects from previous medications, issues managing other chronic medications, need for medication reminders and organizers). • Assess structural issues including unstable housing, lack of income, unpredictable daily schedule, lack of prescription drug coverage, lack of continuous access to medications.
Provide needed resources.	• Provide or refer for mental health and/or substance abuse treatment. • Provide resources to obtain prescription drug coverage, stable housing, social support, and income and food security.
Involve the patient in ARV regimen selection.	• Review regimen potency, potential side effects, dosing frequency, pill burden, storage requirements, food requirements, and consequences of nonadherence. • Assess daily activities and tailor regimen to predictable and routine daily events. • Consider use of fixed-dose combination formulation. • Assess if cost/co-payment for drugs can affect access to medications and adherence.
Assess adherence at every clinic visit.	• Monitor viral load as a strong biologic measure of adherence. • Use a simple behavioral rating scale. • Employ a structured format that normalizes or assumes less-than-perfect adherence and minimizes socially desirable or "white coat adherence" responses. • Ensure that other members of the health care team also assess adherence.
Use positive reinforcement to foster adherence success.	• Inform patients of low or nondetectable levels of HIV viral load and increases in $CD4^+$ cell counts. • When needed, consider providing incentives and rewards for achieving high levels of adherence and treatment success.
Identify the type of and reasons for nonadherence.	• Failure to fill the prescription(s). • Failure to understand dosing instructions. • Complexity of regimen (e.g., pill burden, size, dosing schedule, food requirements). • Pill aversion. • Pill fatigue. • Adverse effects. • Inadequate understanding of drug resistance and its relationship to adherence. • Cost-related issues. • Depression, drug and alcohol use, homelessness, poverty. • Stigma. • Nondisclosure. • Other potential barriers.
Select from among available effective treatment adherence interventions.	• Use evidence-based interventions to promote adherence. • Use adherence-related tools to complement education and counseling interventions (e.g., pill boxes, dose planners, reminder devices). • Use community resources to support adherence (e.g., visiting nurses, community workers, family, peer advocates). • Use patient prescription assistance programs. • Use motivational interviews.

(*Continued*)

(*Continued*)

Systematically monitor retention in care.	• Record and follow-up on missed visits.
On the basis of any problems identified through systematic monitoring, consider options to enhance retention in care given resources available	• Provide outreach for those patients who drop out of care. • Use peer or paraprofessional treatment navigators. • Employ incentives to encourage clinic attendance or recognize positive clinical outcomes resulting from good adherence. • Arrange for directly observed therapy (if feasible).

Adapted from Panel on Antiretroviral Guidelines for Adults and Adolescents (Panel). (2016). Guidelines for the use of antiretroviral agents in HIV-1-infected adults and adolescents. Department of Health and Human Services. Retrieved on 5/12/16 at: www.aidsinfo.nih.gov/ContentFiles/AdultandAdolescentGL.pdf Table 13. Strategies to Improve Adherence to Antiretroviral Therapy and Retention in Care.

muscle and liver). Facial wasting, characterized as a sinking of the cheeks, eyes, and temples caused by the loss of fat tissue under the skin, may be treated by injectable fillers such as poly-L-lactic acid (Sculptra) (see Fig. 55-2). These changes can disturb the body image of people living with HIV/AIDS and may be a reason they decline or stop ART nurses could use an instrument such as the assessment of body change distress (ABCD) questionnaire that assesses subjective report of bodily changes and body dissatisfaction and the impact of bodily changes on psychosocial variables, quality of life, and HIV self-care behaviors (Blashill, Wilson, Baker, et al., 2014).

Nursing Alert: Nurses must recognize the differences among common laboratory tests used to diagnose and assess HIV infection and guide therapy. For example, the EIA is a diagnostic screening test that determines the presence of antibodies to HIV. The RT-PCR test, which measures viral load, is used along with the $CD4^+$ count, which indicates the level of immune dysfunction, to assess the stage and severity of HIV infection. It is important to assess the extent of damage to the immune system before initiation of ART and/or prophylactic treatment for opportunistic infections.

Drug Resistance

Drug resistance is the ability of pathogens to withstand the effects of medications that should be toxic to them. There are two major components of ART resistance: (1) transmission of drug-resistant HIV at the time of initial infection and (2) selective drug resistance in patients who are receiving nonsuppressive regimens. Genotypic and phenotypic resistance assays are used to assess viral strains and inform selection of treatment strategies. Genotypic assays detect drug-resistant mutations present in relevant viral genes while phenotypic assays measure the ability of a virus to grow in different concentrations of ART drugs. Resistance testing in persons who are chronically infected is recommended at the time of entry into HIV care. Although no definitive prospective data exist to support the choice of one type of resistance testing over another, genotypic testing is generally preferred because of lower cost, more rapid turnaround time, the assay's ability to detect mixtures of wild-type and resistant virus, and the relative ease of interpreting test results. If therapy is deferred, repeat testing soon before initiation of ART should be considered because the patient may have acquired drug-resistant virus (i.e., superinfection) (Panel, 2016).

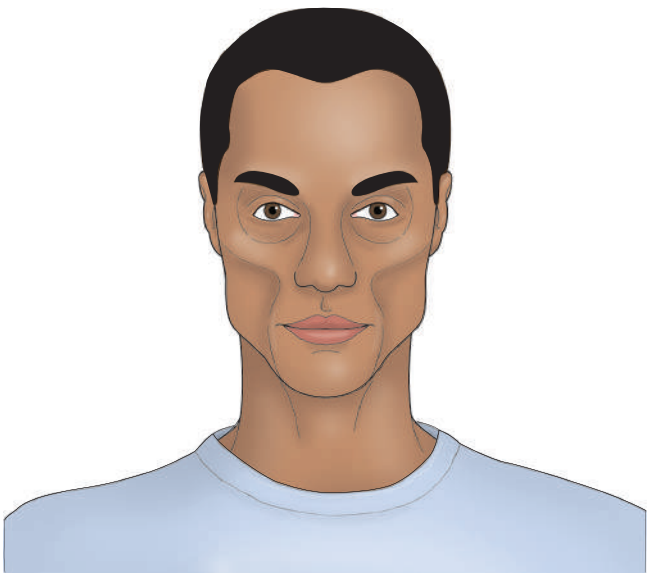


Figure 55-2 • Facial lipoatrophy.

Immune Reconstitution Inflammatory Syndrome

Immune reconstitution inflammatory syndrome (**IRIS**) results from rapid restoration of organism-specific immune responses to infections that cause either the deterioration of a treated infection or new presentation of a subclinical infection. This syndrome typically occurs during the initial months after beginning ART and is associated with a wide spectrum of organisms, most commonly mycobacteria, herpes viruses, and deep fungal infections. IRIS is characterized by fever, respiratory and/or abdominal symptoms, and worsening of the clinical manifestations of an opportunistic infection or the appearance of new manifestations. IRIS is treated with anti-inflammatory medications such as cortisone. The nurse should be alert to the possibility of IRIS, especially in the 3-month period after treatment with ART is initiated, because this syndrome is associated with significant morbidity and patients often require hospital admission.

Paradoxical tuberculosis-associated immune reconstitution inflammatory syndrome (TB-IRIS) is a serious complication that arises during successful ART in patients with HIV-TB co-infection who are receiving TB treatment. In the majority of patients, TB-IRIS occurs within the first few weeks of ART but can occur much later. Patients with HIV-TB co-infection with low $CD4^+$ counts who start ART are at high risk of developing TB-IRIS. Although the immunopathogenesis of TB-IRIS is still not completely understood, the explosive restoration of T-cell function is believed to play a distinct role (Goovaerts, Jennes, Massinga-Loembé, et al., 2015).

Clinical Manifestations

Patients with HIV/AIDS experience a number of symptoms related to the disease, side effects of treatment, and other comorbidities,

Chart 55-9 NURSING RESEARCH PROFILE

Symptom Self-Management Using Technology

Schnall, R., Wantland, D., Velez, O., et al. (2014). Feasibility testing of a web-based symptom self-management system for persons living with HIV. Journal of the Association of Nurses in AIDS Care. 25(4), 364–371.

Purpose

The purpose of this study was to explore the feasibility of using a web-based tool to provide tailored symptom management strategies for persons living with HIV. The web-based system provided tailored strategies for six symptoms: (a) depression, (b) anxiety, (c) fatigue, (d) diarrhea, (e) neuropathy, and (f) nausea. The hypothesis was that using the tool would decrease symptom intensity and frequency.

Design

This quantitative study used repeated-measures to test the components of the web-based system on symptom frequency and intensity, use of symptom management strategies, and engagement with health care providers over a 12-week period. Symptom intensity and frequency was measured by the items related to the six symptoms using the HIV Sign and Symptom Check List-Revised tool. Engagement with care was measured by the Engagement with Health Care Provider Scale.

Findings

The average age of participants was 50 years; the majority were male and most had completed high school ($N = 42$). At baseline, the most frequently reported symptom was fatigue, followed by anxiety. There was a trend toward a decrease in symptom frequency over time for all symptoms except diarrhea, and engagement with health care providers improved. One purpose of a feasibility study is to demonstrate the ability to recruit and retain study participants, which was achieved. Forty-two participants were recruited in 30 days, which demonstrates the interest of patients to use web-based tools to assist with symptom self-management. Almost 80% of the participants completed the 12-week longitudinal study.

Nursing Implications

Web-based tools have the potential to support patients to self-manage symptoms and are accessible to anyone who can access the internet. Patients are interested in and willing to use the web-based tool to manage HIV-related symptoms. Use of this tool decreased symptom intensity and increased engagement with health care providers. This sample was not particularly well educated and yet the intervention was effective. Use of multiple sources of health information should be encouraged by nurses in order to support patients in becoming more informed in self-management strategies.

including pancreatitis, hepatitis, and cardiometabolic abnormalities. The clinical manifestations of HIV/AIDS are widespread and may involve virtually any organ system. Patients in stage 3 or AIDS (see Table 55-2) are severely immune depressed and can develop opportunistic infections. Nurses need to understand the causes, signs and symptoms, and interventions, including self-management strategies that can enhance the quality of life for patients throughout the different stages of the illness. Symptom assessment tools can be used to assess patients' symptom intensity and severity. People with HIV/AIDS use a variety of self-management strategies to minimize common symptoms (Schnall, Wantland, Velez, et al., 2014) (see Chart 55-9).

Respiratory Manifestations

Shortness of breath, dyspnea (labored breathing), cough, chest pain, and fever are associated with various opportunistic infections, such as those caused **by** *Pneumocystis jirovecii, Mycobacterium avium-intracellulare,* cytomegalovirus (CMV), and *Legionella* species.

Pneumocystis Pneumonia

***Pneumocystis* pneumonia (PCP)** is caused by *P. jirovecii* (formerly *P. carinii*) (Panel on Opportunistic Infections in HIV-Infected Adults and Adolescents [OI-Panel], 2015) and the incidence has declined substantially with widespread use of PCP prophylaxis, which is used to prevent PCP, and ART. The most common manifestations of PCP are subacute onset of progressive dyspnea, fever, nonproductive cough, and chest discomfort that worsens within days to weeks. In mild cases, pulmonary examination usually is normal at rest. With exertion, tachypnea, tachycardia, and diffuse dry (cellophane) rales may be auscultated. Oral thrush is a common co-infection. Fever is apparent in most cases and may be the predominant symptom. Hypoxemia is the most characteristic laboratory abnormality, along with elevated lactate dehydrogenase levels. Because clinical presentation, blood tests, and chest radiographs are not pathognomonic for PCP, and because the organism cannot be cultivated routinely, histopathologic or cytopathologic demonstration of organisms in tissue, bronchoalveolar lavage fluid, or induced sputum samples is required for a definitive diagnosis (OI-Panel, 2015).

Mycobacterium avium Complex

***Mycobacterium avium* complex (MAC)** disease is a common opportunistic infection that typically occurs in patients with $CD4^+$ T-lymphocyte ($CD4^+$) cell counts less than 50 cells/mm^3. MAC is caused by infection with different types of mycobacterium: *Mycobacterium avium, Mycobacterium intracellulare,* or *Mycobacterium kansasii.* Early symptoms may be minimal and can precede detectable mycobacteremia by several weeks and include fever, night sweats, weight loss, fatigue, diarrhea, and abdominal pain. A confirmed diagnosis of disseminated MAC disease is based on compatible clinical signs and symptoms coupled with the isolation of MAC from cultures of blood, lymph node, bone marrow, or other normally sterile tissue or body fluids (OI-Panel, 2015).

Tuberculosis

The estimated annual risk of reactivation with TB among those with untreated HIV infection and latent TB infection is 3% to 16% and approximates the lifetime risk for individuals without HIV infection who have latent TB infection. TB disease can occur at any $CD4^+$ T-lymphocyte ($CD4^+$ cell) count, although the risk increases with progressive immune deficiency. Testing for latent TB at the time of HIV diagnosis should be routine, regardless of an individual's risk of TB exposure. Individuals with negative diagnostic tests for latent TB who have stage 3 HIV infection should be retested once their $CD4^+$ count increases due to ART. Screening for symptoms (asking for cough of *any* duration) coupled with chest radiography is recommended to exclude TB disease in a patient with a positive skin test or interferon-gamma release assays. Latent TB in a person with

HIV infection is treated with isoniazid (INH), supplemented with pyridoxine (Aminoxin) to prevent peripheral neuropathy, for 9 months since it has proven efficacy, good tolerability, and infrequent severe toxicity.

TB disease can develop in the lungs as well as in extrapulmonary sites such as the central nervous system (CNS), bone, pericardium, stomach, peritoneum, and scrotum and initial diagnostic testing is directed at the anatomic site of symptoms or signs, such as the lungs, lymph nodes, and cerebrospinal fluid. TB in individuals with advanced immune deficiency can be rapidly progressive and fatal if treatment is delayed and such patients often have smear-negative sputum specimens. Therefore, after collection of available specimens for culture and molecular diagnostic tests, empiric treatment for TB is warranted in patients with clinical and radiographic presentation suggestive of HIV-related TB. Treatment of suspected TB in individuals with HIV infection is the same as for those who are HIV uninfected and should include an initial four-drug combination of isoniazid, rifampin (Rifadin), pyrazinamide, and ethambutol (Etibi) (OI-Panel, 2015).

Gastrointestinal Manifestations

The gastrointestinal manifestations of HIV infection and AIDS include loss of appetite, nausea, vomiting, oral and esophageal candidiasis, and chronic diarrhea. Gastrointestinal symptoms may be related to the direct inflammatory effect of HIV on the cells lining the intestines. Some of the enteric pathogens that occur most frequently, identified by stool cultures or intestinal biopsy, are *Cryptosporidium muris, Salmonella* species, *Isospora belli, Giardia lamblia,* cytomegalovirus (CMV), *Clostridium difficile,* and *M. avium-intracellulare.* In patients with AIDS, the effects of diarrhea can be devastating in terms of profound weight loss (more than 10% of body weight), fluid and electrolyte imbalances, perianal skin excoriation, weakness, and inability to perform the usual activities of daily living.

Candidiasis

Oropharyngeal and esophageal candidiasis (fungal infections) are common in patients with HIV infection. Oropharyngeal candidiasis is characterized by painless, creamy white, plaque-like lesions that can occur on the buccal surface, hard or soft palate, oropharyngeal mucosa, or tongue surface. Lesions can be easily scraped off with a tongue depressor or other instrument which is in contrast to lesions associated with oral hairy leukoplakia. In women with early-stage HIV infection, *Candida* vulvovaginitis usually presents the same as in women without HIV infection, with white adherent vaginal discharge associated with mucosal burning and itching of mild-to-moderate severity and sporadic recurrences (OI-Panel, 2015).

HIV Wasting Syndrome

Wasting syndrome is defined as the involuntary loss of more than 10% of one's body weight while having experienced diarrhea or weakness and fever for more than 30 days. Wasting refers to the loss of muscle mass, although part of the weight loss may also be due to loss of fat.

Oncologic Manifestations

Those with HIV/AIDS are at greater risk of developing certain cancers. These include Kaposi sarcoma (KS), lymphoma, and invasive cervical cancer. KS and lymphomas are discussed next. Cervical carcinoma is described later in the Gynecologic Manifestations section.

Kaposi Sarcoma

KS is caused by human herpesvirus-8 (HHV-8); affects eight times more men than women; and may spread through sexual contact. It involves the epithelial layer of blood and lymphatic vessels. AIDS-related KS exhibits a variable and aggressive course, ranging from localized cutaneous lesions to disseminated disease involving multiple organ systems. Cutaneous signs may be the first manifestation of HIV; they can appear anywhere on the body and are usually brownish pink to deep purple. They may be flat or raised and surrounded by ecchymosis (hemorrhagic patches) and edema (see Fig. 55-3). Rapid development of lesions involving large areas of skin is associated with extensive disfigurement and significant body image issues. The location and size of some lesions can lead to venous stasis, lymphedema, and pain. Ulcerative lesions disrupt skin integrity and increase discomfort and susceptibility to infection. The most common sites of visceral involvement are the lymph nodes, gastrointestinal tract, and lungs. Involvement of internal organs may eventually lead to organ failure, hemorrhage, infection, and death.

Diagnosis of KS is confirmed by biopsy of suspected lesions. Prognosis depends on the extent of the tumor, the presence of other symptoms of HIV infection, and the $CD4^+$ count. Death may result from tumor progression. More often, however, it results from other complications of HIV infection.

AIDS-Related Lymphomas

AIDS-related lymphomas include both Hodgkin lymphoma and non-Hodgkin lymphoma. Non-Hodgkin lymphoma is more common. AIDS-related lymphoma is usually aggressive; there are three main types: diffuse large B-cell; B-cell immunoblastic; and small noncleaved cell lymphoma. Symptoms include weight loss, night sweats, and fever. The complete blood count might be abnormal and a biopsy will confirm the diagnosis (National Cancer Institute [NCI], 2015).

Neurologic Manifestations

HIV-related brain changes have profound effects on cognition, including motor function, executive function, attention, visual memory, and visuospatial function. Neurologic dysfunction



Figure 55-3 • Lesions of the AIDS-related Kaposi sarcoma. Whereas some patients may have lesions that remain flat, others experience extensively disseminated, raised lesions with edema. From DeVita, V. T., Jr., Hellman, S., & Rosenberg, S. (Eds.). (1993). AIDS: Etiology, diagnosis, treatment, and prevention (4th ed.). Philadelphia: Lippincott Williams & Wilkins.

results from direct effects of HIV on nervous system tissue, opportunistic infections, primary or metastatic neoplasm, cerebrovascular changes, metabolic encephalopathies, or complications secondary to therapy. Immune system response to HIV infection in the CNS includes inflammation, atrophy, demyelination, degeneration, and necrosis.

Peripheral Neuropathy

Peripheral neuropathy is the most common neurologic symptom at any stage of HIV infection. It may be a side effect of some ART drugs, and may occur in a variety of patterns, with distal sensory polyneuropathy or distal symmetric polyneuropathy the most frequently occurring type. It can lead to significant pain of feet and hands and functional impairment. Patients use a variety of physical and psychological self-management strategies to minimize this symptom (Nicholas, Corless, & Evans, 2014).

HIV Encephalopathy

HIV encephalopathy was formerly referred to as AIDS dementia complex (see Chart 55-10). It is a clinical syndrome that is characterized by a progressive decline in cognitive, behavioral, and motor functions as a direct result of HIV infection. HIV has been found in the brain and cerebrospinal fluid (CSF) of patients with HIV encephalopathy. The brain cells infected by HIV are predominantly the $CD4^+$ cells of monocyte–macrophage lineage. HIV infection is thought to trigger the release of toxins or lymphokines that result in cellular dysfunction, inflammation, or interference with neurotransmitter function rather than cellular damage.

Signs and symptoms may be subtle and difficult to distinguish from fatigue, depression, or the adverse effects of treatment for infections and malignancies. Early manifestations include memory deficits, headache, difficulty concentrating, progressive confusion, psychomotor slowing, apathy, and ataxia. Later stages include global cognitive impairments, delay in verbal responses, a vacant stare, spastic paraparesis, hyperreflexia, psychosis, hallucinations, tremor, incontinence, seizures, mutism, and death.

Confirming the diagnosis of HIV encephalopathy can be difficult. Extensive neurologic evaluation includes a computed tomography scan, which may indicate diffuse cerebral atrophy and ventricular enlargement. Other tests that may detect abnormalities include magnetic resonance imaging, analysis of CSF through lumbar puncture, and brain biopsy.

Cryptococcus Neoformans

A fungal infection, *Cryptococcus neoformans* is another common opportunistic infection among patients with AIDS, and it causes neurologic disease. Cryptococcal meningitis is characterized by symptoms such as fever, headache, malaise, stiff neck, nausea, vomiting, mental status changes, and seizures. Diagnosis is confirmed by CSF analysis.

Progressive Multifocal Leukoencephalopathy

Progressive multifocal leukoencephalopathy (PML) is a demyelinating CNS disorder that affects the oligodendroglia. Clinical manifestations often begin with mental confusion and rapidly progress to include blindness, aphasia, muscle weakness, paresis (partial or complete paralysis), and death. ART has greatly reduced the threat of mortality associated with this disorder.

Chart 55-10

Care of the Patient with HIV Encephalopathy

Chronic Confusion

- Assess mental status and neurologic functioning.
- Monitor for medication interactions, infections, electrolyte imbalance, and depression.
- Frequently orient the patient to time, place, person, reality, and the environment.
- Use simple explanations.
- Instruct the patient to perform tasks in incremental steps.
- Provide memory aids (clocks and calendars).
- Provide memory aids for medication administration.
- Post activity schedule.
- Give positive feedback for appropriate behavior.
- Educate caretakers about orienting patient to time, place, person, reality, and the environment.
- Encourage the patient to designate a responsible person to assume power of attorney.

Disturbed Sensation

- Assess sensory impairment.
- Decrease amount of stimuli in the patient's environment.
- Correct inaccurate perceptions.
- Provide reassurance and safety if the patient displays fear.
- Provide a secure and stable environment.
- Educate caregivers about recognizing inaccurate sensory perceptions.
- Provide caregivers techniques to correct inaccurate perceptions.
- Instruct the patient and caregivers to report any changes in the patient's vision to the patient's health care provider.

Risk for Injury

- Assess the patient's level of anxiety, confusion, or disorientation.
- Assess the patient for delusions or hallucinations.
- Remove potentially dangerous objects from the patient's environment.
- Structure the environment for safety (ensure adequate lighting, avoid clutter, provide bed rails if needed).
- Supervise smoking.
- Do not let the patient drive a car if confusion is present.
- Instruct the patient and caregiver in home safety.
- Provide assistance as needed for ambulation and in getting in and out of bed.
- Pad headboard and side rails if the patient has seizures.

Self-Care Deficits

- Encourage activities of daily living within the patient's level of ability.
- Encourage independence, but assist if the patient cannot perform an activity.
- Demonstrate any activity that the patient is having difficulty accomplishing.
- Monitor food and fluid intake.
- Weigh patient weekly.
- Encourage the patient to eat, and offer nutritious meals, snacks, and adequate fluids.
- If patient is incontinent, establish a routine toileting schedule.
- Educate caregivers about meeting the patient's self-care needs.

Other Neurologic Disorders

Other infections involving the nervous system include *Toxoplasma gondii,* CMV, and *Mycobacterium tuberculosis* infections.

Depressive Manifestations

Depression and apathy are neuropsychiatric complications of HIV infection. Estimates suggest that the prevalence of current depression is between 30% and 40% in persons with HIV/AIDS. Similarly, apathy, which refers to reduced, self-initiated, cognitive, emotional, and behavioral activity, is also commonly reported among those living with a diagnosis of HIV with rates as high as 65% (Bryant, Whitehead, Burrell, et al., 2015). Alcohol and cocaine use—both current and former—have been associated with depression and apathy in this population, and depression has been associated with less adherence with ART.

Integumentary Manifestations

Cutaneous manifestations are associated with HIV infection and the accompanying opportunistic infections and malignancies. KS (described earlier) and opportunistic infections such as herpes zoster and herpes simplex are associated with painful vesicles that disrupt skin integrity. Molluscum contagiosum is a viral infection characterized by deforming plaque formation. Seborrheic dermatitis is associated with an indurated, diffuse, scaly rash involving the scalp and face. Patients with AIDS may also exhibit a generalized folliculitis associated with dry, flaking skin or atopic dermatitis, such as eczema or psoriasis. Many patients treated with the antibacterial agent trimethoprim–sulfamethoxazole (TMP–SMZ) develop a drug-related rash that is pruritic with pinkish-red macules and papules (Comerford, 2015). Patients with any of these rashes experience discomfort, have body image changes, and are at increased risk for infection from disrupted skin integrity.

Gynecologic Manifestations

Persistent, recurrent vaginal candidiasis may be the first sign of HIV infection in women. Past or present genital ulcers are a risk factor for the transmission of HIV infection. Women with HIV infection are more susceptible to genital ulcers and venereal warts and have increased rates of incidence and recurrence of these conditions. Ulcerative STIs such as chancroid, syphilis, and herpes are more severe in women with HIV infection. Human papillomavirus (HPV) causes venereal warts and is a risk factor for cervical intraepithelial neoplasia, a cellular change that is frequently a precursor to cervical cancer. Women who are HIV seropositive and have cervical carcinoma present at a more advanced stage of disease and have more persistent and recurrent disease and a shorter interval to recurrence and death than women without HIV infection.

Women with HIV are at increased risk for pelvic inflammatory disease, a reportable infection, and the associated inflammation may increase HIV transmission to the uninfected sexual partner. Moreover, women with HIV infection appear to have a higher incidence of menstrual abnormalities, including amenorrhea or bleeding between periods, than do women without HIV infection.

Medical Management

Treatment of Opportunistic Infections

Guidelines for the treatment of opportunistic infections should be consulted for the most current recommendations (OI-Pzanel, 2015). Although ART is highly effective in keeping the $CD4^+$ cell count high, opportunistic infections continue to cause considerable morbidity and mortality for three main reasons: (1) many patients are unaware of their HIV infection and present with an opportunistic infection as the initial indicator of their disease, (2) some patients are aware of their HIV infection but do not take antiretroviral agents because of psychosocial or economic factors, and (3) others receive prescriptions for antiretroviral medications but fail to attain adequate virologic and immunologic response as a result of issues related to adherence, pharmacokinetics, or unexplained biologic factors.

Pneumocystis Pneumonia

Persons in stage 3 HIV infection should receive chemoprophylaxis to prevent PCP with trimethoprim–sulfamethoxazole (TMP–SMX) if they have $CD4^+$ counts less than 200 cells/mm^3 or a history of oropharyngeal candidiasis (OI-Panel, 2015). Once the $CD4^+$ count improves, prophylaxis can be discontinued. When a person is diagnosed with PCP, TMP–SMX is the treatment of choice, lowering the dose if there is abnormal renal function. Adjunctive corticosteroids (Prednisone) are indicated as early as possible, preferentially within 72 hours after starting specific PCP therapy. Treatment duration is usually 21 days; rates of adverse reaction to TMP–SMX are high including rash (30% to 55%) (including Stevens–Johnson syndrome), fever (30% to 40%), leukopenia (30% to 40%), hepatitis (20%), thrombocytopenia (15%), azotemia (1% to 5%), and hyperkalemia. Because long-term survival is possible for patients in whom ART is effective, individuals with AIDS and severe PCP should be given the option to choose mechanical ventilation and critical care management if their functional status is such that it would be appropriate, just as with patients without HIV infection. Paradoxical IRIS has been reported following PCP and starting ART (OI-Panel, 2015).

Mycobacterium avium Complex

Initial treatment of MAC disease should consist of two or more antimycobacterial drugs to prevent or delay the emergence of resistance. Clarithromycin (Biaxin) is the preferred first agent; however, azithromycin (Zithromax) can be substituted for clarithromycin when drug interactions or intolerance to clarithromycin preclude its use. Ethambutol is the recommended second drug (OI-Panel, 2015).

Cryptococcal Meningitis

Cryptococcosis among patients with HIV infection most commonly occurs as a subacute meningitis or meningoencephalitis with fever, malaise, and headache. Treating cryptococcosis consists of three phases: induction, consolidation, and maintenance therapy. The preferred induction treatment for cryptococcal meningitis and other forms of extrapulmonary cryptococcosis is the IV lipid formulation of amphotericin B in combination with fluconazole (Diflucan). Serious potential adverse effects of amphotericin B include anaphylaxis, kidney and hepatic impairment, electrolyte imbalances, anemia, fever, and severe chills. After at least 2 weeks of successful induction therapy—defined as substantial clinical improvement and a negative CSF culture after repeat lumbar puncture—amphotericin B and flucytosine can be discontinued. Follow-up or consolidation therapy is then initiated with oral fluconazole daily which should continue for at least 8 weeks (OI-Panel, 2015).

Cytomegalovirus Retinitis

Retinitis caused by CMV is a leading cause of blindness in patients with AIDS. Oral valganciclovir (Valcyte), IV ganciclovir

(Cytovene), IV ganciclovir followed by oral valganciclovir, IV foscarnet (Foscavir), IV cidofovir (Vistide), and a ganciclovir intraocular implant coupled with valganciclovir are all effective treatments for CMV retinitis (OI-Panel, 2015). All of these drugs have significant toxicities (bone marrow suppression, neutropenia, hepatitis, renal toxicity, seizures, etc.) and are used with caution (Comerford, 2015).

Antidiarrheal Therapy

Although many forms of diarrhea respond to treatment, it is not unusual for this condition to recur and become a chronic problem for the patient with HIV infection. Therapy with octreotide acetate (Sandostatin), a synthetic analog of somatostatin, has been shown to effectively manage chronic severe diarrhea. High concentrations of somatostatin receptors have been found in the gastrointestinal tract and in other tissues. Somatostatin inhibits many physiologic functions, including gastrointestinal motility and intestinal secretion of water and electrolytes.

Chemotherapy

Kaposi Sarcoma

KS can be treated with local therapy, radiation therapy, chemotherapy, and biologic therapy depending upon the location of the lesions.

Lymphoma

There is no standard treatment for AIDS-related peripheral or systemic lymphoma. The treatment plan is adjusted for each patient and usually includes one or more of combination chemotherapy, high-dose chemotherapy and stem cell transplant. There are many ongoing clinical trials (using monoclonal antibodies; different treatment combinations) that patients with AIDS-related lymphoma may be eligible to enter (NCI, 2015).

Antidepressant Therapy

Treatment for depression in people with HIV infection involves cognitive behavioral therapy integrated with pharmacotherapy. If depressive symptoms are severe and of sufficient duration, treatment with antidepressants may be initiated. Antidepressants such as imipramine (Tofranil), desipramine (Norpramin), and fluoxetine (Prozac) may be used, because these medications also alleviate the fatigue and lethargy that are associated with depression. A psychostimulant such as methylphenidate (Ritalin) may be used in low doses in patients with neuropsychiatric impairment. Electroconvulsive therapy may be an option for patients with severe depression who do not respond to pharmacologic interventions.

Nutrition Therapy

Alterations in lipid metabolism are associated with HIV infection and ART. Malnutrition increases the risk of infection and the incidence of opportunistic infections. Nutrition therapy should be part of the overall management plan and should be tailored to meet the nutritional needs of the patient, whether by oral diet, enteral tube feedings, or parenteral nutritional support, if needed. As with all patients, a healthy diet is essential for the patient with HIV infection. For all patients with AIDS who experience unexplained weight loss, calorie counts and weight monitoring should be obtained to evaluate nutritional status and initiate appropriate therapy. The goal is to maintain the ideal weight and, when necessary, to increase weight.

Appetite stimulants have been successfully used in patients with AIDS-related anorexia. Megestrol acetate (Megace), a synthetic oral progesterone preparation, promotes significant weight gain and inhibits cytokine IL-1 synthesis. In patients with HIV infection, it increases body weight primarily by increasing body fat stores. Dronabinol (Marinol), which is a synthetic tetrahydrocannabinol (THC), the active ingredient in marijuana, has been used to relieve nausea and vomiting associated with cancer chemotherapy. After beginning dronabinol therapy, almost all patients with HIV infection experience a modest weight gain. The effects on body composition are unknown.

Oral supplements may be used when the diet is deficient in calories and protein. Ideally, oral supplements should be lactose free (people with HIV infection may be intolerant to lactose), high in calories and easily digestible protein, low in fat with the fat easily digestible, palatable, inexpensive, and tolerated without causing diarrhea. Nutritional supplements have been developed specifically for people with HIV infection and AIDS. Parenteral nutrition is the final option because of its prohibitive cost and associated risks, including possible infection.

Complementary, Alternative, and Integrative Health Therapies

People with HIV infection report use of complementary, alternative, and integrative therapies. Combined with traditional therapies, these may improve the patient's overall well-being. However, there can be adverse drug–drug interactions between certain therapies.

Many patients who use these therapies do not report their use to their health care providers. To obtain a complete health history, the nurse should ask about the patient's use of complementary, alternative, and integrative therapies. Patients may need to be encouraged to report their use of these therapies to their primary provider. Problems may arise, for example, when patients are using complementary, alternative, and integrative therapies while participating in clinical drug trials; alternative therapies can have significant adverse side effects, making it difficult to assess the effects of the medications in the clinical trial. The nurse needs to become familiar with the potential adverse side effects of these therapies. The nurse who suspects that complementary, alternative, and integrative therapies is causing a side effect needs to discuss this with the patient, the alternative therapy provider, and the primary provider. The nurse needs to view complementary, alternative, and integrative therapies with an open mind and try to understand the importance of this treatment to the patient. This approach will improve communication with the patient and reduce conflict.

Supportive Care

Patients who are weak and debilitated as a result of chronic illness associated with HIV infection and AIDS typically require many kinds of supportive care. Nutritional support may be as simple as providing assistance in obtaining or preparing meals. For patients with more advanced nutritional impairment resulting from decreased intake, wasting syndrome, or gastrointestinal malabsorption associated with diarrhea, parenteral feedings may be required. Imbalances that result from nausea, vomiting, and profuse diarrhea often necessitate IV fluid and electrolyte replacement.

Management of skin breakdown associated with KS, perianal skin excoriation, or immobility entails thorough and meticulous

skin care that involves regular turning, cleansing, and applications of medicated ointments and dressings. To combat pain associated with skin breakdown, abdominal cramping, peripheral neuropathy, or KS, the nurse administers analgesic agents at regular intervals around the clock. Patients with a history of drug abuse will need to have tailored approaches for pain management. Relaxation and guided imagery may help reduce pain and anxiety.

Pulmonary symptoms, such as dyspnea and shortness of breath, may be related to opportunistic infections, KS, or fatigue. For patients with these symptoms, oxygen therapy, relaxation training, and energy conservation techniques may be effective. Patients with severe respiratory dysfunction may require mechanical ventilation. Before mechanical ventilation is instituted, the procedure is explained to the patient and the caregiver.

As noted previously, with the advent of ART, there are generally more positive outcomes than could be achieved a few years ago, and a patient mechanically ventilated has a reasonable likelihood of survival. However, if the patient decides to forego mechanical ventilation, their wishes must be followed. Ideally, the patient has prepared an advance directive identifying preferences for treatments and end-of-life care, including hospice care. If the patient has not identified preferences in advance, treatment options are described so that the patient can make informed decisions and have those wishes respected.

Nurses should anticipate that patients as well as family and friends will need support and time to share concerns. In some family systems, more than one person might be living with HIV/AIDS.

NURSING PROCESS

The Patient with HIV/AIDS

The nursing care of patients with HIV/AIDS is challenging because of the potential for any organ system to be involved due to infections or cancer. In addition, this disease is complicated by many emotional, social, and ethical issues. The plan of care for the patient with AIDS (see Chart 55-11) is individualized to meet the needs of the patient. Care includes many of the interventions and concerns cited in the Supportive Care section.

Assessment

Nursing assessment includes identification of potential risk factors, including a history of risky sexual practices or IV/injection drug use. The patient's physical status and psychological status are assessed. All factors affecting immune system functioning are thoroughly explored. A number of instruments can be used to assess symptoms and self-management strategies (Fierz, Nicca, & Spirig, 2013).

Nutritional Status

Nutritional status is assessed by obtaining a dietary history and identifying factors that may interfere with oral intake, such as anorexia, nausea, vomiting, oral pain, or difficulty swallowing. In addition, the patient's ability to purchase, prepare, and store food safely is assessed. Weight history (i.e., changes over time), anthropometric measurements, and blood urea nitrogen (BUN), serum protein, albumin, and transferrin levels provide objective measurements of nutritional status.

Skin Integrity

The skin and mucous membranes are inspected daily for evidence of breakdown, ulceration, or infection. The oral cavity is monitored for redness, ulcerations, and the presence of creamy-white patches indicative of candidiasis. Assessment of the perianal area for excoriation and infection in patients with profuse diarrhea is important. Wounds are cultured to identify infectious organisms.

Respiratory Status

Respiratory status is assessed by monitoring the patient for cough, sputum production (i.e., amount and color), shortness of breath, orthopnea, tachypnea, and chest pain. The presence and quality of breath sounds are investigated. Other measures of pulmonary function include chest x-ray results, arterial blood gas values, pulse oximetry, and pulmonary function test results.

Neurologic Status

Neurologic status is determined by assessing level of consciousness; orientation to person, place, and time; and memory lapses. Mental status is assessed as early as possible to provide a baseline. The patient is also assessed for sensory deficits (visual changes, headache, or numbness and tingling in the extremities), motor involvement (altered gait, paresis, or paralysis), and seizure activity.

Fluid and Electrolyte Balance

Fluid and electrolyte status is assessed by examining the skin and mucous membranes for turgor and dryness. Dehydration may be indicated by increased thirst, decreased urine output, postural hypotension, weak and rapid pulse, and urine-specific gravity of 1.025 or more. Electrolyte imbalances, such as decreased serum sodium, potassium, calcium, magnesium, and chloride, typically result from profuse diarrhea. The patient is assessed for signs and symptoms of electrolyte deficits, including decreased mental status, muscle twitching, muscle cramps, irregular pulse, nausea and vomiting, and shallow respirations.

Knowledge Level

The patient's level of knowledge about the disease, modes of disease transmission, and adherence to ART are evaluated. In addition, the level of knowledge of family (biologic and family of choice) and friends is assessed. The patient's psychological reaction to the diagnosis of HIV infection or AIDS is important to explore. Reactions vary among patients and may include denial, anger, fear, shame, withdrawal from social interactions, and depressive symptoms. It is often helpful to gain an understanding of how the patient has dealt with illness and major life stresses in the past. The patient's resources for support are also identified.

Diagnosis

Nursing Diagnoses

The list of potential nursing diagnoses is extensive because of the complex nature of HIV/AIDS. However, based on the assessment data, major nursing diagnoses may include the following:

- Impaired skin integrity related to cutaneous manifestations of HIV infection, excoriation, and diarrhea
- Diarrhea related to enteric pathogens or HIV infection
- Risk for infection related to immune deficiency
- Activity intolerance related to weakness, fatigue, malnutrition, impaired fluid and electrolyte balance, and hypoxia associated with pulmonary infections
- Chronic confusion related to cognitive changes associated with HIV encephalopathy
- Ineffective airway clearance related to infection, increased bronchial secretions, and decreased ability to cough related to weakness and fatigue

Chart 55-11 PLAN OF NURSING CARE

Care of the Patient with AIDS

NURSING DIAGNOSIS: Diarrhea related to enteric pathogens or HIV infection
GOAL: Resumption of usual bowel habits

Nursing Interventions	Rationale	Expected Outcomes
1. Assess patient's normal bowel habits.	1. Provides baseline for evaluation	• Exhibits return to normal bowel patterns • Reports decreasing episodes of diarrhea and abdominal cramping • Identifies and avoids foods that irritate the gastrointestinal tract • Takes appropriate therapy as prescribed • Exhibits normal stool cultures • Maintains adequate fluid intake • Maintains body weight and reports no additional weight loss • States rationale for avoiding smoking • Enrolls in program to stop smoking • Uses medication as prescribed • Maintains adequate fluid status • Exhibits normal skin turgor, moist mucous membranes, adequate urine output, and absence of excessive thirst
2. Assess for diarrhea: frequent, loose stools; abdominal pain or cramping, volume of liquid stools, and exacerbating and alleviating factors.	2. Detects changes in status, quantifies loss of fluid, and provides basis for nursing measures
3. Obtain stool cultures, and administer antimicrobial therapy as prescribed.	3. Identifies pathogenic organism; therapy targets specific organism
4. Initiate measures to reduce hyperactivity of bowel. a. Maintain food and fluid restrictions as prescribed. Suggest BRAT diet (*b*ananas, *r*ice, *a*pplesauce, *t*ea, and *t*oast). b. Discourage smoking. c. Avoid bowel irritants such as fatty or fried foods, raw vegetables, and nuts. Offer small, frequent meals.	4. Promotes bowel rest, which may decrease acute episodes a. Reduces stimulation of bowel b. Eliminates nicotine, which acts as bowel stimulant c. Prevents stimulation of bowel and abdominal distention and promotes adequate nutrition
5. Administer anticholinergic antispasmodics and opioids or other medications as prescribed.	5. Decreases intestinal spasms and motility
6. Maintain fluid intake of at least 3 L/day unless contraindicated.	6. Prevents hypovolemia

NURSING DIAGNOSIS: Risk for infection related to immune deficiency
GOAL: Absence of infection

Nursing Interventions	Rationale	Expected Outcomes
1. Monitor for infection: fever, chills, and diaphoresis; cough; shortness of breath; oral pain or painful swallowing; creamy-white patches in oral cavity; urinary frequency, urgency, or dysuria; redness, swelling, or drainage from wounds; vesicular lesions on face, lips, or perianal area.	1. Allows for early detection of infection, essential for prompt initiation of treatment. Repeated and prolonged infections contribute to patient's debilitation.	• Identifies reportable signs and symptoms of infection • Reports signs and symptoms of infection if present • Exhibits and reports absence of fever, chills, and diaphoresis • Exhibits normal (clear) breath sounds without adventitious breath sounds • Maintains weight • Reports adequate energy level without excessive fatigue • Reports absence of shortness of breath and cough • Exhibits pink, moist oral mucous membranes without fissures or lesions • Takes appropriate therapy as prescribed • Experiences no infection • States rationale for strategies to avoid infection • Modifies activities to reduce exposure to infection or infectious persons • Practices "safer sex" • Avoids sharing eating utensils and toothbrush • Exhibits normal body temperature • Uses recommended techniques to maintain cleanliness of skin, skin lesions, and perianal area • Has others handle pet excreta and cleanup • Uses recommended cooking techniques
2. Educate patient or caregiver about need to report possible infection.	2. Allows early detection of infection
3. Monitor white blood cell (WBC) count and differential.	3. Elevated WBC count possibly associated with infection
4. Obtain cultures of wound drainage, skin lesions, urine, stool, sputum, mouth, and blood as prescribed. Administer antimicrobial therapy as prescribed.	4. Assists in determining offending organism to initiate appropriate treatment
5. Instruct patient in ways to prevent infection. a. Clean kitchen and bathroom surfaces with disinfectants. b. Clean hands thoroughly after exposure to body fluids. c. Avoid exposure to others' body fluids or sharing eating utensils. d. Turn, cough, and deep breathe, especially when activity is decreased. e. Maintain cleanliness of perianal area. f. Avoid handling pet excreta or cleaning litter boxes, birdcages, or aquariums. g. Cook meat and eggs thoroughly.	5. Minimizes exposure to infection and transmission of HIV infection to others
6. Maintain aseptic technique when performing invasive procedures such as venipunctures, bladder catheterizations, and injections.	6. Prevents hospital-acquired infections

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NURSING DIAGNOSIS: Ineffective airway clearance related to *Pneumocystis* pneumonia, increased bronchial secretions, and decreased ability to cough related to weakness and fatigue
GOAL: Improved airway clearance

Nursing Interventions	Rationale	Expected Outcomes
1. Assess and report signs and symptoms of altered respiratory status, tachypnea, the use of accessory muscles, cough, color and amount of sputum, abnormal breath sounds, dusky or cyanotic skin color, restlessness, confusion, or somnolence.	1. Indicates abnormal respiratory function	• Maintains normal airway clearance: – Respiratory rate <20 breaths/min – Unlabored breathing without the use of accessory muscles and flaring nares (nostrils) – Skin color pink (without cyanosis) – Alert and aware of surroundings – Arterial blood gas values normal – Normal breath sounds without adventitious breath sounds
2. Obtain sputum sample for culture as prescribed. Administer antimicrobial therapy as prescribed.	2. Aids in identification of pathogenic organisms	• Begins appropriate therapy
3. Provide pulmonary care (cough, deep breathing, postural drainage, and vibration) every 2–4 hours.	3. Prevents stasis of secretions and promotes airway clearance	• Takes medication as prescribed • Reports improved breathing • Maintains clear airway
4. Assist patient in attaining semi- or high Fowler position.	4. Facilitates breathing and airway clearance	• Coughs and takes deep breaths every 2–4 hours as recommended
5. Encourage adequate rest periods.	5. Maximizes energy expenditure and prevents excessive fatigue	• Demonstrates appropriate positions and practices postural drainage every 2–4 hours
6. Initiate measures to decrease viscosity of secretions. a. Maintain fluid intake of at least 3 L/day unless contraindicated. b. Humidify inspired air as prescribed. c. Consult with primary provider concerning the use of mucolytic agents delivered through nebulizer or intermittent positive pressure breathing treatment.	6. Facilitates expectoration of secretions; prevents stasis of secretions	• Reports reduced breathing difficulty when in semi- or high Fowler position • Practices energy-conserving strategies and alternates rest with activity • Demonstrates reduction in thickness (viscosity) of pulmonary secretions • Reports increased ease in coughing up sputum • Uses humidified air or oxygen as prescribed and indicated
7. Perform tracheal suctioning as needed.	7. Removes secretions if patient is unable to do so	• Indicates need for assistance with removal of pulmonary secretions
8. Administer oxygen therapy as prescribed.	8. Increases availability of oxygen	• Understands need for and cooperates with endotracheal intubation and the use of a mechanical ventilator
9. Assist with endotracheal intubation; maintain ventilator settings as prescribed.	9. Maintains ventilation	• Verbalizes concerns about respiratory difficulty, intubation, and mechanical ventilation

NURSING DIAGNOSIS: Imbalanced nutrition: less than body requirements related to decreased oral intake
GOAL: Intake of nutrients sufficient to meet metabolic needs

Nursing Interventions	Rationale	Expected Outcomes
1. Assess nutritional status with height, weight, age; blood urea nitrogen, serum protein, albumin, transferrin, hemoglobin, and hematocrit levels; and cutaneous anergy.	1. Provides objective measurement of nutritional status	• Identifies factors limiting oral intake, and uses resources to promote adequate dietary intake • Reports increased appetite • States understanding of nutritional needs • Identifies ways to reduce factors that limit oral intake • Rests before meals • Eats in pleasant, odor-free environment • Arranges meals to coincide with visitors' visits • Reports increased dietary intake • Uses oral hygiene before meals
2. Obtain dietary history, including likes and dislikes and food intolerances.	2. Defines need for nutritional education; helps individualize interventions	
3. Assess factors that interfere with oral intake.	3. Provides basis and directions for interventions	
4. Consult with dietitian to determine patient's nutritional needs.	4. Facilitates meal planning	
5. Reduce factors limiting oral intake. a. Encourage patient to rest before meals.	5. Addresses factors limiting intake. a. Minimizes fatigue, which can decrease appetite	

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b. Plan meals so that they do not occur immediately after painful or unpleasant procedures.	b. Decreases noxious stimuli	
c. Encourage patient to eat meals with visitors or others when possible.	c. Limits social isolation	
d. Encourage patient to prepare simple meals or to obtain assistance with meal preparation if possible.	d. Limits energy expenditure	
e. Serve small, frequent meals: 6/day.	e. Prevents overwhelming patient	
f. Limit fluids 1 hour before meals and with meals.	f. Reduces satiety	
6. Instruct patient in ways to supplement nutrition: consume protein-rich foods (meat, poultry, fish) and carbohydrates (pasta, fruit, breads).	6. Provides additional proteins and calories	• Takes analgesic agents before meals as prescribed • Identifies ways to increase protein and caloric intake • Identifies foods high in protein and calories • Consumes foods high in protein and calories • Reports decreased rate of weight loss • Maintains adequate caloric intake • States rationale for enteral or parenteral nutrition if needed • Demonstrates skill in preparing alternate sources of nutrition
7. Consult with primary provider and dietitian about alternative feeding (enteral or parenteral nutrition).	7. Provides nutritional support if patient is unable to take sufficient amounts by mouth	
8. Consult with social worker or community liaison about financial assistance if patient cannot afford food.	8. Increases availability of resources and nutrition	

NURSING DIAGNOSIS: Deficient knowledge related to means of preventing HIV transmission
GOAL: Increased knowledge concerning means of preventing disease transmission

Nursing Interventions	Rationale	Expected Outcomes
1. Instruct patient, family, and friends about routes of transmission of HIV.	1. Knowledge about disease transmission can help prevent spread of disease; may also alleviate fears.	• Patient, family, and friends state means of transmission • Reports and demonstrates practices to reduce exposure of others to HIV • Demonstrates knowledge of safer sexual practices • Identifies means of preventing disease transmission • States that sexual partners are informed about patient's positive HIV status in blood • Avoids IV/injection drug use and sharing of drug equipment with others • Understands risks and benefits associated with PrEP
2. Instruct patient, family, and friends about means of preventing transmission of HIV.	2. Reduces transmission risk	
a. Avoid sexual contact with multiple partners, and use precautions if sexual partner's HIV status is not certain.	a. The risk of infection increases with the number of sexual partners, male or female, and sexual contact with those who engage in high-risk behaviors.	
b. Use condoms during sexual intercourse (vaginal, anal, oral–genital); avoid mouth contact with the penis, vagina, or rectum; avoid sexual practices that can cause cuts or tears in the lining of the rectum, vagina, or penis.	b. Risk of HIV transmission is reduced.	
c. Avoid sex with sex workers and others at high risk.	c. Many sex workers are infected with HIV through sexual contact with multiple partners or IV/injection drug use.	
d. Do not use IV/injection drugs; if addicted and unable or unwilling to change behavior, use clean needles and syringes.	d. Clean needles and syringes are the only way to prevent HIV transmission for those who continue to use drugs. Taking precautions is important for those who are antibody positive to prevent transmitting HIV.	
e. Women who may have been exposed to HIV through sexual or drug practices should consult with a physician before becoming pregnant; consider the use of antiretroviral agents if pregnant.	e. HIV can be transmitted from mother to child in utero; the use of antiretroviral agents during pregnancy significantly reduces perinatal transmission of HIV.	
f. Consider using PrEP	f. Taking ART before engaging in high-risk activity seems to protect against infection.	

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NURSING DIAGNOSIS: Social isolation related to stigma of the disease, withdrawal of support systems, isolation procedures, and fear of infecting others
GOAL: Decreased sense of social isolation

Nursing Interventions	Rationale	Expected Outcomes
1. Assess patient's usual patterns of social interaction.	1. Establishes basis for individualized interventions	• Shares with others the need for valued social interaction • Demonstrates interest in events, activities, and communication • Verbalizes feelings and reactions to diagnosis, prognosis, and life changes • Identifies modes of transmission of HIV • States ways of preventing transmission of HIV to others while maintaining contact with valued friends and relatives • Reveals HIV/AIDS diagnosis to others when appropriate • Identifies resources (i.e., family, friends, and support groups such as Indian Network for positive people (INP Plus), Saathi, ASHA, etc (see Resources section) • Uses resources when appropriate • Accepts offers of assistance and support • Reports decreased sense of isolation • Maintains contacts with those of importance to him or her • Develops or continues hobbies that effectively serve as diversion or distraction
2. Observe for behaviors indicative of social isolation, such as decreased interaction with others, hostility, noncompliance, sad affect, and stated feelings of rejection or loneliness.	2. Promotes early detection of social isolation, which may be manifested in several ways	
3. Provide instruction concerning modes of transmission of HIV.	3. Provides accurate information, corrects misconceptions, and alleviates anxiety	
4. Assist patient to identify and explore resources for support and positive mechanisms for coping (e.g., contact with family, friends)	4. Enables mobilization of resources and supports	
5. Allow time to be with patient other than for medications and procedures.	5. Promotes feelings of self-worth and provides social interaction	
6. Encourage participation in diversional activities such as reading, television, or handcrafts.	6. Provides distraction	

Collaborative Problems: Opportunistic infections; impaired breathing; wasting syndrome and fluid and electrolyte imbalances; adverse reaction to medications
Goal: Absence of complications

Nursing Interventions	Rationale	Expected Outcomes
Opportunistic Infections		
1. Monitor vital signs including temperature.	1. Changes in vital signs such as increases in pulse rate, respirations, blood pressure, and temperature may indicate infection.	• Exhibits stable vital signs • Experiences control of infection • Identifies signs and symptoms correctly and experiences no complications • Identifies signs and symptoms that are reportable to the primary provider • Takes medications as prescribed
2. Obtain laboratory specimens, and monitor test results.	2. Smears and cultures can identify causative agents such as bacteria, fungi, and protozoa, and sensitivity studies can identify antibiotics or other medications effective against the causative agent.	
3. Instruct the patient and caregiver about signs and symptoms of infection and the need to report them early.	3. Early recognition of symptoms facilitates prompt treatment and avoids extra complications.	
Impaired Breathing		
1. Monitor respiratory rate and pattern.	1. Rapid shallow breathing, diminished breath sounds, and shortness of breath may indicate respiratory failure resulting in hypoxia.	• Maintains stable respiratory rate and pattern within the normal limits • Exhibits no adventitious lung sounds; normal breath sounds • Has stable pulse rate and blood pressure within normal limits, and exhibits no evidence of hypoxia • Oxygen saturation levels within acceptable range
2. Auscultate the chest for breath sounds and abnormal lung sounds.	2. Crackles and wheezes may indicate fluid in the lungs, which disrupts respiratory function and alters the blood's oxygen-carrying capacity.	
3. Monitor pulse rate, blood pressure, and oxygen saturation levels.	3. Changes in pulse rate, blood pressure, and oxygen levels may indicate the development of respiratory or cardiac failure.	

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Wasting Syndrome and Fluid and Electrolyte Disturbances		
1. Monitor weight and laboratory values for nutritional status.	1. Weight loss, malnutrition, and anemia are common in HIV infection and increase risk of superinfection.	• Maintains stable weight • Eats a nutritious diet • Attains and maintains hemoglobin, hematocrit, and ferritin levels within normal limits
2. Monitor intake and output and laboratory values for fluid and electrolyte imbalance (potassium, sodium, calcium, phosphorus, magnesium, and zinc).	2. Chronic diarrhea, inadequate oral intake, vomiting, and profuse sweating deplete electrolytes. Small intestine inflammation may impair the absorption of fluids and electrolytes.	• Sustains fluid and electrolyte balance within normal limits
3. Monitor for and report signs and symptoms of dehydration.	3. Fluid loss results in decreased circulating volume leading to tachycardia, dry skin and mucous membranes, poor skin turgor, elevated urine specific gravity, and thirst. Early detection allows early treatment.	• Exhibits no signs and symptoms of dehydration
Reactions to Medications		
1. Monitor for medication interactions.	1. People with HIV infection receive many medications for HIV and for disease complications. Early detection of medication interactions is necessary to prevent complications.	• Experiences no serious side effects or complications from medications • Correctly describes medication regimen and complies with therapy, including adaptations in eating routines and type of food used with prescribed medications
2. Monitor for and promptly report side effects from antiretroviral agents.	2. Side effects from antiretroviral agents can be life threatening. Serious side effects include anemia, pancreatitis, peripheral neuropathy, mental confusion, and persistent nausea and vomiting. Corrective measures need to be instituted.	
3. Instruct the patient and caregiver in the medication regimen.	3. Knowledge of the medication purpose, correct administration, side effects, and strategies to manage or prevent side effects promotes safety and greater compliance with treatment.	

- Acute and chronic pain related to impaired perianal skin integrity secondary to diarrhea, KS, and peripheral neuropathy
- Imbalanced nutrition: less than body requirements related to decreased oral intake
- Social isolation related to stigma of the disease, withdrawal of support systems, isolation procedures, and fear of infecting others
- Grieving related to changes in lifestyle and roles and unfavorable prognosis
- Deficient knowledge related to HIV infection, means of preventing HIV transmission, ART, and self-management strategies

Collaborative Problems/Potential Complications

Possible complications may include the following:

- Opportunistic infections
- Impaired breathing or respiratory failure
- Wasting syndrome and fluid and electrolyte imbalance
- Adverse effects of medications
- Body image changes

Planning and Goals

Goals for the patient may include achievement and maintenance of skin integrity, resumption of usual bowel patterns, absence of infection, improved activity tolerance, coherent thought processes, improved airway clearance, increased comfort, improved nutritional status, increased socialization, expression of grief, increased knowledge regarding disease prevention and self-care, and absence of complications.

Nursing Interventions

Promoting Skin Integrity

The skin and oral mucosa are assessed routinely for changes in appearance, location and size of lesions, and evidence of infection and breakdown. The patient is encouraged to maintain a balance between rest and mobility whenever possible. Patients who are immobile are assisted to change position at least every 2 hours and more often as needed. Devices such as alternating-pressure mattresses and low-air-loss beds are used to prevent skin breakdown. Patients are encouraged to avoid scratching, to use nonabrasive, nondrying soaps, and to apply nonperfumed skin moisturizers to dry skin. Regular oral care is also encouraged.

Medicated lotions, ointments, and dressings are applied to affected skin surfaces as prescribed. Adhesive tape is avoided. Skin surfaces are protected from friction and rubbing by keeping bed linens free of wrinkles and avoiding tight or restrictive clothing. Patients with foot lesions are advised to wear cotton socks and shoes that do not cause the feet to perspire. Antipruritic, antibiotic, and analgesic agents are given as prescribed.

The perianal region is assessed frequently for impairment of skin integrity and infection. The patient is instructed to keep the area as clean as possible. The perianal area is cleaned after each bowel movement with nonabrasive soap and water to prevent further excoriation and breakdown of the skin and infection. If the area is very painful, soft cloths or cotton sponges may be less irritating than washcloths. In addition, sitz baths or gentle irrigation may facilitate cleaning and promote comfort. The area is dried thoroughly after cleaning. Topical lotions or ointments may be prescribed to promote healing. Wounds are cultured if infection is suspected so that the appropriate antimicrobial treatment can be initiated. Debilitated patients may require assistance in maintaining hygienic practices.

Promoting Usual Bowel Patterns

Bowel patterns are assessed for diarrhea. The nurse monitors the frequency and consistency of stools and the patient's reports of abdominal pain or cramping associated with bowel movements. Factors that exacerbate frequent diarrhea are also assessed. The quantity and volume of liquid stools are measured to document fluid volume losses. Stool cultures are obtained to identify pathogenic organisms.

The patient is counseled about ways to decrease diarrhea. The primary provider may recommend restriction of oral intake to rest the bowel during periods of acute inflammation associated with severe enteric infections. As the patient's dietary intake is increased, foods that act as bowel irritants, such as raw fruits and vegetables, popcorn, carbonated beverages, spicy foods, and foods of extreme temperatures, should be avoided. Small, frequent meals help to prevent abdominal distention. Medications, such as anticholinergic agents, antispasmodic agents, or opioids, can be prescribed to decrease diarrhea by reducing intestinal spasms and motility. Administering antidiarrheal agents on a regular schedule may be more beneficial than administering them on an as-needed basis. Antibiotics and antifungal agents may also be prescribed to combat pathogens identified by stool cultures. Assessment of the patient's self-care strategies is essential.

Preventing Infection

The patient and caregivers are instructed to monitor for signs and symptoms of infection: fever; chills; night sweats; cough with or without sputum production; shortness of breath; difficulty breathing; oral pain or difficulty swallowing; creamy-white patches in the oral cavity; unexplained weight loss; swollen lymph nodes; nausea; vomiting; persistent diarrhea; frequency, urgency, or pain on urination; headache; visual changes or memory lapses; redness, swelling, or drainage from skin wounds; and vesicular lesions on the face, lips, or perianal area. The nurse also monitors laboratory test results that indicate infection, such as the white blood cell count and differential. Cultures of specimens from wound drainage, skin lesions, urine, stool, sputum, mouth, and blood are obtained to identify pathogenic organisms and the most appropriate antimicrobial therapy.

Improving Activity Tolerance

Activity tolerance is assessed by monitoring the patient's ability to ambulate and perform activities of daily living. Patients may be unable to maintain their usual levels of activity because of weakness, fatigue, shortness of breath, dizziness, and neurologic involvement. Assistance in planning daily routines that maintain a balance between activity and rest may be necessary. In addition, patients benefit from instructions about energy conservation techniques, such as sitting while washing or preparing meals. Personal items that are frequently used should be kept within the patient's reach. Measures such as relaxation and guided imagery may be beneficial because they decrease anxiety, which contributes to weakness and fatigue.

Collaboration with other members of the health care team may uncover other factors associated with increasing fatigue and strategies to address them. For example, if fatigue is related to anemia, administering epoetin alfa (Epogen) as prescribed may relieve fatigue and increase activity tolerance.

Maintaining Coherent Thought Processes

The patient is assessed for alterations in mental status that may be related to neurologic involvement, metabolic abnormalities, infection, side effects of treatment, and coping mechanisms. Manifestations of neurologic impairment may be difficult to distinguish from psychological reactions to HIV infection, such as anger and depression.

If the patient experiences altered mental or cognitive status, family and support network members are instructed to speak to the patient in simple, clear language and give the patient sufficient time to respond to questions. Reorientation to surroundings and location is conducted as needed. The patient's support network is encouraged to orient the patient to the daily routine by talking about what is taking place during daily activities and providing the patient with a regular daily schedule for medication administration, grooming, meal times, bedtimes, and awakening times. Posting the schedule in a prominent area (e.g., on the refrigerator), providing nightlights for the bedroom and bathroom, and planning safe leisure activities allow the patient to maintain a regular routine in a safe manner. Activities that the patient previously enjoyed are encouraged. These should be easy to accomplish and fairly short in duration. The nurse encourages the social support network to remain calm and not to argue with the patient while protecting the patient from injury. Around-the-clock supervision may be necessary, and strategies can be implemented to prevent the patient from engaging in potentially dangerous activities, such as driving, using the stove, or mowing the lawn. Strategies for improving or maintaining functional abilities and for providing a safe environment are used for patients with HIV encephalopathy and other cognitive impairments (see Chart 55-10).

Improving Airway Clearance

Respiratory status, including rate, rhythm, the use of accessory muscles, and breath sounds, as well as mental status and skin color, must be assessed at least daily. Any cough and the quantity and characteristics of sputum are documented. Sputum specimens are analyzed for infectious organisms. Pulmonary therapy (coughing, deep breathing, postural drainage, percussion, and vibration) is provided as often as every 2 hours to prevent stasis of secretions and to promote airway clearance. Because of weakness and fatigue, many patients require assistance in attaining a position (such as a high Fowler position or semi-Fowler position) that facilitates breathing and airway clearance. Adequate rest is essential to minimize energy expenditure and prevent excessive fatigue. The fluid volume status is evaluated so that adequate hydration can be maintained. Unless contraindicated because of kidney or cardiac disease, daily intake of 3 L of fluid is encouraged. Humidified oxygen may be prescribed, and nasopharyngeal or tracheal suctioning, intubation, and mechanical ventilation may be necessary to maintain adequate ventilation.

Relieving Pain and Discomfort

The patient is assessed for the quality and severity of pain associated with impaired perianal skin integrity, the lesions of KS, and peripheral neuropathy. In addition, the effects of pain on elimination, nutrition, sleep, affect, and communication are explored, along with exacerbating and relieving factors. Cleaning the perianal area, as described previously, can promote comfort. Topical anesthetic medications or ointments may be prescribed. The use of soft cushions or foam pads may increase comfort while sitting. The patient is instructed to avoid foods that act as bowel irritants. Antispasmodic and antidiarrheal medications may be prescribed to reduce the discomfort and frequency of bowel movements. If necessary, systemic analgesic agents may also be prescribed. Pain from KS is frequently described as a sharp, throbbing pressure, and heaviness, if lymphedema is present. Pain management may include the use of nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids plus nonpharmacologic approaches such as relaxation techniques. When NSAIDs are given to patients who are receiving ART, hepatic and hematologic status must be monitored (Comerford, 2015).

The patient with pain related to peripheral neuropathy frequently describes it as burning, numbness, and "pins and needles." Pain management approaches may include topical ointments, opioids, and tricyclic antidepressants. Tricyclic antidepressants can be helpful in controlling the symptoms of neuropathic pain (Comerford, 2015). They also potentiate the actions of opioids and can be used to relieve pain without increasing the dose of the opioid.

Improving Nutritional Status

Nutritional status is assessed by monitoring weight; dietary intake; and serum albumin, BUN, protein, and transferrin levels. The patient is also assessed for factors that interfere with oral intake, such as anorexia, oral and esophageal candida infection, nausea, pain, weakness, fatigue, and lactose intolerance. Based on the results of assessment, the nurse can implement specific measures to facilitate oral intake. The dietitian is consulted to determine the patient's nutritional requirements.

Control of nausea and vomiting with antiemetic medications given on a regular basis may increase the patient's dietary intake. Inadequate food intake resulting from pain caused by oral lesions or a sore throat may be managed by administering prescribed opioids and viscous lidocaine (the patient is instructed to rinse the mouth and swallow). Additionally, the patient is encouraged to eat foods that are easy to swallow and to avoid spicy or sticky food items and foods that are excessively hot or cold. Oral hygiene before and after meals is encouraged. If fatigue and weakness interfere with intake, the nurse encourages the patient to rest before meals. If the patient is hospitalized, meals should be scheduled so that they do not occur immediately after painful or unpleasant procedures. The patient with diarrhea and abdominal cramping is encouraged to avoid foods that stimulate intestinal motility and abdominal distention, such as fiber-rich foods or lactose, if the patient is intolerant to lactose. The patient is instructed about ways to enhance the nutritional value of meals. Adding eggs, butter, or fortified milk (milk to which powdered skim milk has been added to increase the caloric content) to gravies, soups, or milkshakes can provide additional calories and protein. High-calorie, nutritional foods such as puddings, powders, milkshakes, and nutritional supplements may also be useful. Patients who cannot maintain their nutritional status through oral intake may require enteral feedings or parenteral nutrition.

Decreasing the Sense of Isolation

People with AIDS are at risk for double stigmatization. They have what society refers to as a "dreaded disease," and they may have a lifestyle that differs from what is considered acceptable by many people. The diagnosis might prompt disclosure about hidden lifestyles or behaviors to family, friends, coworkers, and health care providers. As a result, people with HIV infection may be overwhelmed with emotions such as anxiety, guilt, shame, and fear. They also may be faced with multiple losses, such as loss of financial security, normal roles and functions, self-esteem, privacy, ability to control bodily functions, ability to interact meaningfully with the environment, and sexual functioning as well as rejection by sexual partners, family, and friends. Some patients may harbor feelings of guilt because of their lifestyle or because they may have infected others in current or previous relationships. Other patients may feel anger toward sexual partners who transmitted the virus to them. Infection control measures used in the hospital or at home may further contribute to the patient's emotional isolation. Any or all of these stressors may cause the patient with AIDS to withdraw both physically and emotionally from social contact.

Nurses are in a key position to provide an atmosphere of acceptance and understanding for people with AIDS and their social networks. The patient's usual level of social interaction is assessed as early as possible to provide a baseline for monitoring changes in behaviors that suggest social isolation (e.g., decreased interaction with staff or family, hostility, nonadherence). Patients are encouraged to express feelings of isolation and loneliness, with the assurance that these feelings are not unique or abnormal.

Providing information about how to protect themselves and others may help patients avoid social isolation. Patients, family, and friends must be reassured that HIV is not spread through casual contact. Education of ancillary personnel, nurses, and physicians helps reduce factors that might contribute to patients' feelings of isolation. Patient care conferences that address the psychosocial issues associated with HIV/AIDS may help sensitize the health care team to patients' needs.

Coping With Grief

The nurse can help the patient verbalize feelings and explore and identify resources for support and mechanisms for coping, especially when the patient is grieving anticipated losses. The patient is encouraged to maintain contact with family, friends, and coworkers and AIDS support groups. If possible, losses are identified and addressed. The patient is encouraged to continue usual activities whenever possible. Consultations with mental health counselors are useful for many patients and their families.

Improving Knowledge of HIV

The patient and family are educated about HIV infection, means of preventing HIV transmission, ART, and appropriate self-care measures. Information about the purpose of the medications, their correct administration, side effects, and strategies to manage or prevent side effects is provided. The patient is instructed to avoid others with active infections, such as upper respiratory infections.

Monitoring and Managing Potential Complications

Opportunistic Infections. Patients who are severely immunosuppressed are at risk for opportunistic infections. Therefore, anti-infective agents may be prescribed and laboratory tests obtained to monitor their effect. Signs and symptoms of opportunistic infections, including fever, malaise,

difficulty breathing, nausea or vomiting, diarrhea, difficulty swallowing, and any occurrences of swelling or discharge, should be reported as treated as indicated.

Respiratory Failure. Impaired breathing is a major complication that increases the patient's discomfort and anxiety and may lead to respiratory and cardiac failure. The respiratory rate and pattern are monitored, and the lungs are auscultated for abnormal breath sounds. The patient is instructed to report shortness of breath and increasing difficulty in carrying out usual activities. Pulse rate and rhythm, blood pressure, and oxygen saturation are monitored. Suctioning and oxygen therapy may be prescribed to ensure an adequate airway and to prevent hypoxia. Mechanical ventilation may be necessary for the patient who cannot maintain adequate ventilation as a result of pulmonary infection, fluid and electrolyte imbalance, or respiratory muscle weakness. Arterial blood gas values are used to guide ventilator settings. If the patient is intubated, methods must be established to allow communication with the nurse and others. The patient receiving mechanical ventilation will require support to cope with the stress associated with intubation and ventilator assistance. The use of mechanical ventilation should be consistent with the patient's decisions about end-of-life treatment. Further discussion of end-of-life care can be found in Chapter 59.

Wasting Syndrome. Wasting syndrome and fluid and electrolyte disturbances, including dehydration, are common complications of stage 3 of infection. The patient's nutritional and electrolyte status is evaluated by monitoring weight gains or losses, skin turgor, ferritin levels, hemoglobin and hematocrit values, and electrolyte levels. Fluid and electrolyte status is monitored on an ongoing basis; fluid intake and output and urine-specific gravity may be monitored daily if the patient is hospitalized with complications. The skin is assessed for dryness and adequate turgor. Vital signs are monitored for decreased systolic blood pressure or increased pulse rate on sitting or standing. Signs and symptoms of electrolyte disturbances, such as muscle cramping, weakness, irregular pulse, decreased mental status, nausea, and vomiting, are documented and reported to the primary provider. Serum electrolyte values are monitored, and abnormalities are reported.

The nurse helps the patient select foods that will replenish electrolytes, such as oranges and bananas (potassium) and cheese and soups (sodium). A fluid intake of 3 L or more per day, unless contraindicated, is encouraged to replace fluid lost with diarrhea, and measures to control diarrhea are initiated. If fluid and electrolyte imbalances persist, the nurse administers IV fluids and electrolytes as prescribed. Effects of parenteral therapy are monitored.

Side Effects of Medications. Adverse effects are of concern in patients who receive many medications to treat HIV infection or its complications. Many medications can cause severe toxic effects. Patients and their caregivers need to know which signs and symptoms of side effects should be reported immediately to their primary provider (see Table 55-4).

In addition to medications used to treat HIV infection, other medications that may be required include opioids, tricyclic antidepressants, and NSAIDs for pain relief; medications for treatment of opportunistic infections; antihistamines (diphenhydramine [Benadryl]) for relief of pruritus; acetaminophen/paracetamol (Tylenol) or aspirin for management of fever; and antiemetic agents for control of nausea and vomiting. Concurrent use of these medications can cause many drug interactions, resulting in hepatic and hematologic abnormalities. Therefore, careful monitoring of laboratory test results is essential.

During each contact with the patient, the nurse not only asks about side effects, but also about how well the patient is adhering to the medication regimen. To promote adherence, the nurse should assist the patient to organize and plan the medication schedule.

Body Image Changes. Body image changes often occur in patients with HIV and are an important collaborative problem. The nurse helps the patient verbalize feelings and explore and identify resources for support and mechanisms for coping with body image changes. Consultations with mental health counselors may be indicated for patients adjusting to body image changes.

Promoting, Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. Patients, families, and friends are educated about the routes of transmission of HIV. As discussed earlier, the nurse discusses precautions the patient can use to avoid transmitting HIV sexually (see Charts 55-2 and 55-3) or through sharing of body fluids, especially blood. Patients and their families or caregivers must receive instructions about how to prevent disease transmission, including handwashing techniques and methods for safely handling and disposing of items soiled with body fluids. Clear guidelines about avoiding and controlling infection, keeping regular health care appointments, symptom management, nutrition, rest, and exercise are necessary (see Chart 55-12). The importance of personal and environmental hygiene is emphasized. Caregivers are taught hand hygiene and appropriate infection prevention precautions (see Chapter 1, Charts 1-4 and 1-5). Kitchen and bathroom surfaces should be cleaned regularly with disinfectants to prevent growth of fungi and bacteria. Patients with pets are encouraged to have another person clean areas soiled by animals, such as birdcages and litter boxes. If this is not possible, patients should use gloves to clean the area and then wash their hands afterward. Patients are advised to avoid exposure to others who are sick or who have been recently vaccinated, especially with live vaccine. The importance of avoiding smoking, excessive alcohol, and over-the-counter and street drugs is emphasized. Patients who are HIV positive or who inject drugs are instructed not to donate blood. IV/injection drug users who are unwilling to stop using drugs are advised to avoid sharing drug equipment with others.

Caregivers in the home are taught how to administer medications, including IV preparations. The medication regimens used for patients with HIV infection and AIDS are often complex and expensive. Patients receiving combination therapies for the treatment of HIV infection and its complications require careful education about the importance of taking medications as prescribed and explanations and assistance in fitting the medication regimen into their lives (see Chart 55-8). If the patient requires enteral or parenteral nutrition, instruction is provided to the patient and family about how to administer nutritional therapies at home. Nurses provide ongoing education and support for the patient and family.

Continuing and Transitional Care. Many people with HIV/AIDS remain in their community and continue their usual daily activities, whereas others can no longer work or maintain their independence. Families or caregivers may need assistance in providing supportive care. Many community-based

Chart 55-12 HOME CARE CHECKLIST

Infection Prevention for the Patient with Immune Deficiency

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of immune deficiency on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State changes in lifestyle (e.g., hygiene, activity) necessary to decrease risk for infection.
  - Maintain good hand hygiene technique before eating, after using the bathroom, and before and after performing health care procedures.
  - Maintain total body hygiene and foot care to prevent bacterial and fungal diseases.
  - Maintain skin integrity, using cream and emollients to prevent or manage dry, chafed, or cracked skin.
  - Maintain good oral hygiene and dental checkups.
  - Avoid people with infections, recent vaccinations, and crowds.
  - Perform deep breathing; use incentive spirometer every 4 hours while awake if mobility is restricted.
  - Provide adequate lubrication with gentle vaginal manipulation during sexual intercourse; avoid anal intercourse.
- State changes in home environment necessary to decrease risk for infection.
  - Avoid cleaning birdcages and litter boxes; consider avoiding garden work (soil) and fresh flowers in stagnant water.
  - Identify the rationale for frequent cleaning of kitchen and bathroom surfaces with disinfectant.
- Verbalize understanding of ways to maintain a nutritious diet and adequate calories and necessary changes to decrease risk of infection.
  - State the reason for avoiding the eating of raw fruits and vegetables, cooking all foods thoroughly, and immediately refrigerating all leftover food.
- Identify rationale and benefits of avoiding alcohol, tobacco, and unprescribed medications.
- State the name, dose, side effects, frequency, and schedule for all medications.
- Verbalize ways to cope with stress successfully, plans for regular exercise, and rationale for obtaining adequate rest.
- Identify signs and symptoms of infection to report to the primary provider, such as fever; chills; wet or dry cough; breathing problems; white patches in the mouth; swollen glands; nausea; vomiting; persistent abdominal pain; persistent diarrhea; problems with urination or changes in the character of the urine; red, swollen, or draining wounds; sores or lesions on the body; persistent vaginal discharge with or without itching; and severe fatigue.
- Demonstrate how to monitor for signs of infection.
- Describe to whom, how, and when to report signs of infection.
- Describe appropriate actions to take should infection occur.

ADL, activities of daily living; IADL, independent activities of daily living.

organizations provide a variety of services for people living with HIV infection and AIDS; nurses can help identify these services.

Home, community-based, transitional, and hospice nurses are in an excellent position to provide the support and guidance that is so often needed in the home setting. Home care nurses are key to the safe and effective administration of parenteral antibiotics, chemotherapy, and nutrition in the home.

During home visits, the nurse assesses the patient's physical and emotional status and home environment. The patient's adherence to the therapeutic regimen is assessed, and strategies are suggested to assist with adherence. The patient is assessed for progression of disease and for adverse side effects of medications. Previous education is reinforced, and the importance of keeping follow-up appointments is stressed.

Complex wound care or respiratory care may be required in the home. Patients and families are often unable to meet these skilled care needs without assistance. Nurses may refer patients to community programs that offer a range of services for patients, friends, and families, including help with housekeeping, hygiene, and meals; transportation and shopping; individual and group therapy; support for caregivers; telephone networks for the homebound; and legal and financial assistance. These services are typically provided by both professionals and nonprofessional volunteers. A social worker may be consulted to identify sources of financial support, if needed.

Home care and hospice nurses are increasingly called on to provide physical and emotional support to patients and families as patients with AIDS enter the terminal stages of disease. This support takes on special meaning when people with AIDS lose friends and when family members fear the disease or feel anger concerning the patient's lifestyle. The nurse encourages the patient and family to discuss end-of-life decisions and to ensure that care is consistent with those decisions, all comfort measures are employed, and the patient is treated with dignity at all times.

Evaluation

Expected patient outcomes may include:

1. Maintains skin integrity
2. Resumes usual bowel habits
3. Experiences no infections
4. Maintains adequate level of activity tolerance
5. Maintains usual thought processes
6. Maintains effective airway clearance
7. Experiences increased sense of comfort and less pain
8. Maintains adequate nutritional status
9. Experiences decreased sense of social isolation
10. Progresses through grieving process
11. Reports increased understanding of AIDS, prevention of HIV transmission, and ART, and participates in self-management strategies as possible
12. Remains free of complications

Detailed outcomes are included in the plan of nursing care for a patient with AIDS (see Chart 55-11).

National AIDS Control Program (NACP)–India

The Govt. of India has been implementing National AIDS Control Program (NACP) successfully since 1992. The first edition of NACP concentrated on awareness creation, measures to improve accessibility of safe blood, and preventive services

for at risk groups. NACP II revision was done in 1999. The National AIDS prevention policy was initiated in 2002 to consolidate the strategies toward capacity building to tackle the AIDS epidemic on long-term basis and to accelerate the preventive and control measures. As a part of the program, national antiretroviral therapy program was initiated and adolescent counseling and testing centers were opened.

The third phase of the program (NACP III) was launched in 2007 with the objective of halting and reversing the HIV epidemic in India. Scientifically evolved and strategically implemented NACP III touched its target through strengthening central, state, district, and gross root level technical, managerial, and administrative resources.

The fourth phase of the program (NACP IV), launched in July 2015, concentrates on reducing the incidence through intensifying the preventive measures to control spread among high-risk groups and vertical transmission.

The second priority of NACP IV is to intensify information, education, and counseling services to facilitate behavior change among general public and high-risk groups. The third component of the program is to provide comprehensive care, support, and services to those people living with HIV. The program will adopt measures to integrate the PLHIV into the mainstream by ending discrimination through insurance and other social safety initiatives.

It also aims at capacity building of NGOs in high-epidemic northeastern states. Strengthening the managerial, information, and surveillance systems at all levels from the central down the peripheral level will be implemented in phase IV of the program.

National Strategic Plan 2017–2024 for Prevention of HIV/AIDS and STI

The Ministry of Health and Family Welfare, Govt. of India, is committed to end AIDS epidemic by 2030.

After the NACP implementation, the incidence rate has reduced by 64% in the 10-year period between 2000–2010 but subsequently incidence rate declined slowly. There was 0.28% incidence of AIDS in 2012, which reduced to only 0.26% in 2015.

To intensify and accelerate the activities and efforts to ensure target achievement by the year 2030, the government and NACO have floated the national strategic plan for 7-year period (2017–2024) on December 1st, 2017, World AIDS Day. To make substantial progress, NSP has fixed aims for 2020 and 2024. By the year 2020, the target of 90-90-90 is aimed, which means 90% of the country's people tested positive know their HIV status, 90% of the tested positive people are treated, and 90% of the treated people achieve effective viral load reduction. Similarly, by 2024 the planners aim to achieve 95% of the target of ending AIDS and 85% reduction in number of new cases (NACO, 2017).

The Five Priorities of NSP

1. Speed up the prevention of HIV among the at-risk group and key population namely injectable drug users, transgenders, male-to-male sex partners, female sex workers, truck drivers who go for long travel, and male single migrants
2. Provision of high-quality HIV testing and access to comprehensive ART for all
3. Elimination of vertical transmission of HIV and syphilis from mother to child
4. Collaboration with NGOs, civil community societies, and people living with HIV for effective program implementation
5. Reorganization and transformation of the existing strategic information system into efficient patient centric one (Adopted from the National Strategic Plan 2017–2024, NACO, 2017)

The NSP plan calls for a more concerted effort to reduce high-risk behavior among target population groups of injectable drug users, transgenders, as well as adolescents through the following proposed interventions:

- Mobile testing units are planned to achieve the target of 90-90-90 for facility-based testing, community-based testing, and self-testing.
- Multipronged approach is proposed to address high-risk behavior among adolescent population through enhancing awareness through sexual and reproductive health education and by integrating the adolescent program with the National Health Mission.
- Prevention of parent-to-child transmission by integrated testing and counseling of all pregnant women.
- Prevention, early diagnosis, and treatment of co-morbid infections such as tuberculosis, Hepatitis B and C, and sexually transmitted infections.
- Effective treatment regimens with efforts to improve adherence to treatment and reduce the number of dropouts from treatment.
- Improvement in ART adherence by community involvement and collaboration with NGOs.
- Revamping the communication system to a more patient centric and effective one.

NACP V (2021 to 2026)

The NACP V focuses on lengthening the survival with an improved quality of life for PLHIV through prompt early identification, initiation, and compliance to ART. It aims at zero new infection, zero new deaths attributable to AIDS, and zero discrimination for PLHIV. The current stage of NACP employs more patient-centered and community-oriented testing and treatment services.

National AIDS Control Organization (NACO)

The NACO is a branch of the Ministry of Health and Family Welfare of the Government of India. It controls and implements the activities of National AIDS Control Programme in India. Under the NACO's leadership, 35 HIV prevention and control societies are functioning. The aims of the NACO are AIDS prevention and treatment of people living with HIV. Through state AIDS control societies and NGOs, the NACO creates wide awareness and life skills programs for high-risk adolescent population.

Activities of the NACO

1. **Prevention of AIDS:** Targeted activities such as sensitization programs, facilitation of voluntary testing services, and promotion of safe behaviors are carried out for the at-risk groups such as commercial sex workers, transgender population, homosexuals, drug addicts, migrant laborers, and truck drivers.
2. **Information, education, and communication (IEC):** Mass communication and multimedia communication strategies are utilized for the creation of awareness about the mode of transmission, methods of prevention, availability of free testing and treatment services.

3. **Testing:** Free testing and counseling services are provided for all at-risk individuals and volunteers by the NACO.
4. **Treatment services:** Free treatment of first-line, second-line, and third-line ART is delivered to all those who are enrolled under the National Aids Control Programme. Currently, single-window HIV and TB treatment delivery is carried out at all ART centers.
5. **Laboratory services:** Under the NACO directions, free diagnostic services are available. Quality-ensured testing of viral load and CD4 count are carried out. The state-level and six national-level laboratories are involved in the testing of viral loads, etc.
6. **Collaboration and partnership:** In collaboration with towering personalities, NGOs, and Ministry of Health and Family Welfare officials, the NACO carries out its prevention and facilitation of treatment services.
7. **Strategic information and leadership:** The NACO provides strategic plans and evidence-based guidelines.

HIV/AIDS (Control and Prevention) ACT, 2017

To end discrimination on the basis of HIV, the Government of India has enacted a law called HIV/AIDS (Control and Prevention) Act 2017. All the healthcare providers and every nurse in India must be aware of the HIV/AIDS Act, 2017, and its implications. Salient aspects of the law are presented below.

- The preamble of HIV/AIDS Act prohibits discrimination of any kind toward "people living with HIV (PLHIV)" and they are entitled equal rights like other citizens. The act prohibits unfair treatment in employment or educational institutions or any business establishments.
- Only on the basis of written assessment and certification from qualified healthcare provider that the occupation poses risk of transmission of HIV to other persons in the workplace or unfit to perform duties, HIV-positive person may be denied employment.
- The act prohibits discontinuation of medical/healthcare services or unfair treatment in healthcare facility on the basis of HIV status.
- PLHIV are entitled to privileges and power to hold private and public office. They have the right to reside, or for entertainment, in any place they like and should not be denied accommodation.
- The law prohibits testing any individual for HIV without his or her consent and it should be done after appropriate pretest counseling. The results of the test should be announced only by the physician who is treating the individual or the qualified counselor with proper posttest counseling.
- The test results can be informed to the sexual partner or spouse by the physician or counselor in person after counseling.
- Or the HIV-positive person may be encouraged or counseled to reveal the test result.
- The act does not make it obligatory on his or her part to identify the sexual partner and inform.
- It should be noted by the nurses that they are not entitled to reveal the test results to anyone. Healthcare providers including nurses may reveal to other healthcare professional involved in his or her care so that the appropriate transmission prevention can be taken.
- The healthcare agency is legally obligated to protect the documents and keep it confidential.
- The healthcare agency is obligated legally to give training on universal precaution to all its employees and ensure availability of resources for following universal precaution and postexposure prophylaxis.

International Agencies on AIDS Control

The global action against HIV is the sponsored program by many nongovernmental organizations such as the International AIDS Society, the Global Fund, UNAIDS, and World Health Organization (HIV.gov, 2021).

1. **The Global Fund:** It aims at stepping up the efforts to end AIDS, malaria, and tuberculosis. The Global Fund spends more than $4 billion a year toward this cause. Concerted efforts of the Global Fund resulted in 50% reduction in new cases and AIDS-related mortality.
2. **International AIDS Society:** The International Aids Society is the largest association in the world dedicated to AIDS control. It has membership from more than 170 countries across the globe. Through research and scholarly activities, it aims at providing evidence-based guidelines for HIV and AIDS prevention and control. It also engages in capacity building through organizing international HIV conferences.
3. **UNAIDS:** It is another international organization which has focused on global efforts to end public health threat posed by HIV within the year 2030 so that the sustainable development goals can be achieved.
4. **World Health Organization:** It is the strategic global body of the United Nations in health-related matter that contributes greatly to mitigate the effects of HIV, hepatitis, and sexually transmitted infections through one of its departments, the Department of Global HIV, Hepatitis, and Sexually Transmitted Infection Programmes (HHS).

Counseling Services for HIV

The NACO (2016) mandates adherence to the guidelines for testing and counseling for HIV. Prior to HIV screening test, all patients need to undergo pretest counseling and informed consent needs to be obtained. The five Cs of testing, namely, consent, confidentiality, counseling, correctness of result, and contact detail of the partner, need to be adhered to (NACO, 2016). Audiovisual privacy needs to be ensured during testing. If the screening test result is positive, then the confirmatory test should be performed in dedicated standalone testing centers to facilitate further treatment and follow-up (NACO, 2016).

Pretest Counseling

- Ensure that history taking and assessment are carried out with adequate privacy.
- Provide information about HIV, the mode of transmission, the window period, and the importance of testing.
- Educate about menstrual and reproductive hygiene, use of condoms, etc.
- Educate about the need for partner testing.
- Ensure that the personal information and the results will be maintained confidentially.
- Clarify the doubts of the patients with an open mind and acceptance. Apply the communication techniques such as listening, questioning, and appropriate use of body language while interacting.
- Perform quick assessment for signs and symptoms of sexually transmitted diseases.

Post-test Counseling

Post-test counseling may be needed for both persons with positive and those with negative screening test results.

- **Counseling for individuals with negative test results:** Provide information about the test results. Educate about the need for maintaining menstrual and sexual hygiene, and effective use of condoms.
- **Counseling for individuals with positive results:** Individuals need to be educated about the test results. Educate about undergoing further confirmatory test. Counsel the need for testing the sexual partner. Fill the linkage form for undergoing the confirmatory test at the integrated counseling and testing center. The following points need to be considered while counseling the patients:
  - The test's positive result may be a crisis.
  - The patients may need time to share their feelings, desperation, fear about social implications, etc. Some may deny their test status.
  - Showing concern and acceptance by the nurse is very important to facilitate successful coping with the HIV.
  - Explain that the ART is totally free of cost. Explain about the need for taking medicines as prescribed, their side effects, and the advantages of consuming a nutritious diet.
  - Explain the need for testing of the sexual partner if he or she is untested.
  - Assess the risk for depression, suicidal thoughts, and other mental health issues that may arise following the test's positivity.
  - In case of any such issues, provide follow-up counseling and further referral to a mental health specialist.
  - Facilitate coping by referring the patient to PLHIV support groups.
  - Clarify the patient's doubts and concerns.

Rehabilitation of PLHIV/Patients With AIDS

HIV is a chronic condition and the rehabilitation in the context of HIV is defined as a dynamic process including any prevention and/or treatment activities and services that address body impairments, activity limitations, and social participation restrictions for an individual (Perazzo et al., 2018). The nurse needs to address all the aspects of improving the quality of life by reducing the possibility of opportunistic infections and risk reduction related to CAD or other comorbid conditions. Social isolation is shown to cause depression and nonadherence. Nurses can work with the patient with HIV, family members, consulting physician, physiotherapist, occupational therapist, social worker, and support group team members.

Some of rehabilitative interventions are the following:

- Physiotherapy
- Self-management education skills in relation to medication adherence
- Dietary modification
- Abstinence from smoking and alcohol
- Conducting PLHIV support group meetings
- Occupational therapy consultations

Emotional and Ethical Concerns

Nurses in all settings are called on to provide care for patients with HIV infection. In doing so, they encounter not only the physical challenges of this epidemic but also emotional and ethical concerns. The concerns raised by health care professionals involve issues such as fear of infection, responsibility for giving care, values clarification, confidentiality, developmental stages of patients and caregivers, and poor prognostic outcomes.

Many patients with HIV infection have engaged in "stigmatized" behaviors. Because these behaviors challenge some traditional religious and moral values, nurses may feel reluctant to care for these patients. In addition, health care providers may still have fear and anxiety about disease transmission despite education concerning infection control and the low incidence of transmission to health care providers (see Chart 55-13). Nurses are encouraged to examine their personal beliefs and to use the process of values clarification to approach controversial issues.

Nurses are responsible for protecting the patient's right to privacy by safeguarding confidential information. Inadvertent disclosure of confidential patient information may result in personal, financial, and emotional hardships for the patient. The controversy surrounding confidentiality concerns the circumstances in which information may be disclosed to others. Health care team members need accurate patient information to conduct assessment, planning, implementation, and evaluation of patient care. Failure to disclose HIV status could compromise the quality of patient care. Sexual partners of patients infected with HIV should know about the potential for infection and the need to engage in safer sex practices, as well as the possible need for testing and health care.

During the early years of the AIDS epidemic, the mortality rate was high. But medication advances have controlled the disease progression, resulting in what is called "functional cure" or HIV remission, which is characterized by viral loads at low or undetectable levels (Vanham, Buvé, Florence, et al., 2014). Many strategies have been used by nurses to cope with the stress associated with caring for patients with AIDS. Education and provision of up-to-date information help to alleviate apprehension and prepare nurses to deliver safe, high-quality patient care. Interdisciplinary meetings allow participants to support one another and provide comprehensive patient care. Staff support groups give nurses an opportunity to solve problems and explore values and feelings about caring for patients with AIDS and their families; they also provide a forum for grieving. Other sources of support include nursing administrators, and peers.

CRITICAL THINKING EXERCISES

1. A 43-year-old man who is an IV drug user and in a committed relationship wants to reduce the risk of HIV infection. What is the evidence base on strategies to reduce risk from use of IV/injection drugs? What is the evidence about the effectiveness of needle exchange programs? What is the evidence for the effectiveness of PrEP? How would you determine the strength of the evidence and how would you present information to him?
2. A 20-year-old female college student comes to the student health clinic stating she had unprotected sex with a partner she suspects is HIV positive. What further questions do you have for her? What is your priority focus for her physical examination? What diagnostic tests and treatments may you anticipate?
3. A 45-year-old female tested positive for HIV started on ART at the integrated testing and treatment center. After few months, she did not come for the follow-up and did not collect her ART medicines. Describe your approach and plans to promote adherence with ART and other medications since the patient is taking multiple different medications many times during the day.

Chart 55-13 ETHICAL DILEMMA

Under What Circumstances May a Nurse Refuse to Care for a Patient?

Case Scenario

You are the charge nurse in the Intensive Care Unit (ICU). A 52-year-old male patient, who is married but is bisexual, is admitted with pneumocystic pneumonia. His bisexual status is unknown to his spouse. He appears malnourished and emaciated. His laboratory findings indicate he has HIV. His wife has been at his bedside daily but is unaware that he has HIV. The nurse assigned to care for him tells you, "I cannot believe what he has done to his wife! She is at his bedside and has no idea about his double lifestyle. I am a Christian and I want nothing to do with a man with no morals. I think someone needs to tell her the truth but it won't be me! I'm not going to take care of him—give me another assignment."

Discussion

Some health care providers may display a judgmental manner when providing care for patients with HIV/AIDS. The negative attitude often leads to a significant decrease in patient satisfaction regarding their health care. The Indian Nursing council (INC) clearly stipulates that nurses have an obligation to "provide fair and equal treatment to all patients" and also stipulates in its *Code of Ethics* for nurses in India, that nurses must provide fair and equitable treatment to all individuals regardless of gender, socioeconomic status, religious, culture, or sexual orientation

Analysis

- Does a nurse have the right to refuse treating a patient? What if a nurse refuses to care for a patient because he or she believes that by doing so the nurse may suffer harm or it may conflict with tenets of their religious beliefs?
- There are several statements that the staff nurse in this case makes with regard to this patient assignment. Analyze each of these in turn. Does the staff nurse demonstrate respect for the patient's autonomy? Is he or she adhering to the ethical principles of beneficence and nonmaleficence? Is the nurse's actions and statements in conflict with the Code of Ethics? see Chart 2-3
- What might be the legal implications of the staff nurse refusing this assignment? As the charge nurse, how would you act to ensure that applicable hospital policies are adhered to, that you do not permit any type of negligent or other potentially criminal act to occur, and that the patient and his partner receive just and equitable health care?
- What responsibility does the health care team have to the patient's wife? Since her health may be at risk due to her husband's disease, does the health care provider have an obligation to disclose the patient's diagnosis? Does the health care team have any responsibility to inform the patient's sexual partners of his HIV status? What health agencies must be notified of this patient's newly diagnosed HIV status?

References

Code of Ethics for nurses in India. Retrieved on 31.5.2018 at https://www.tamilnadunursingcouncil.com/uploads/circularpdf/professional_code_of_ethics.pdf

American Nurses Association. (2016). Position statement on the nurse's role in ethics and human rights: Protecting and promoting individual worth, dignity, and human rights in practice settings. Retrieved on 8/28/2016 at: www.nursingworld.org/MainMenuCategories/EthicsStandards/Ethics-Position-Statements/NursesRole-EthicsHumanRights-PositionStatement.pdf

Indian Nursing Council (2006). Ethical guidelines for biomedical research on human subjects, New Delhi.

Li, L., Comulada, W.S., Wu, Z., et al. (2011). Providers HIV avoidance and attitude and patient satisfaction. Health Connection, 16, 105–112.

See Chapter 2, Chart 2-6 for ethics resources.

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

American Nurses Association (ANA). (2015). Code of ethics for nurses with interpretive statements. Silver Spring, MD: Author.

American Nurses Association. (2016). Position statement on the nurse's role in ethics and human rights: Protecting and promoting individual worth, dignity, and human rights in practice settings. Retrieved on 8/28/2016 at: www.nursingworld.org/MainMenuCategories/EthicsStandards/Ethics-Position-Statements/NursesRole-EthicsHumanRights-PositionStatement.pdf

Antiretroviral therapy guidelines for HIV infected adults and adolescents, NACO (2013). Retrieved on May 27th, 2018, at: http://naco.gov.in/sites/default/files/Antiretroviral%20Therapy%20Guidelines%20for%20HIV-Infected%20Adults%20and%20Adolescents%20May%202013%281%29_0.pdf

Blaese, R., Stiehm, E., Bonilla, F., et al. (2013). Patient & family handbook for primary immunodeficiency diseases (5th ed.). Towson, MD: Immune Deficiency Foundation.

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Grossman, S. & Porth, C. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

Blashill, A., Wilson, J. Baker, et al., (2014). Assessing appearance-related disturbances in HIV- infected men who have sex with men (MSM): Psychometrics of the body change and distress questionnaire—Short Form (ABCD-SF). AIDS Behavior, 18(6), 1075–1084.

Bosse, J. D., Nesteby, A., & Randall, C. E. (2015). Integrating sexual minority health issues into a health assessment class. Journal of Professional Nursing, 31(6) 498–507.

Bryant, V., Whitehead, N., Burrell, L., et al. (2015). Depression and apathy among people living with HIV: Implications for treatment of HIV. Associated Neurocognitive Disorders. AIDS and Behavior, 19(8), 1430–1437.

Bureau of HIV/AIDS Prevention and Control. (2014). Comprehensive jurisdictional plan for HIV prevention in New York City 2012–2016. Retrieved on 5/11/2016 at: www.nyc.gov/html/doh/downloads/pdf/ah/jurisdictional-plan-cdc.pdf

**Centers for Disease Control and Prevention (CDC). (2006). Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. Retrieved on 5/31/6102 at: www.cdc.gov/mmwr/preview/mmwrhtml/rr5514a1.htm

**Centers for Disease Control and Prevention (CDC). (2007). 2007 Guideline for isolation precautions: Preventing transmission of infectious agents in healthcare settings. Retrieved on 5/13/2016 at: www.cdc.gov/hicpac/2007ip/2007ip_part1.html

Centers for Disease Control and Prevention (CDC). (2013). Condoms and STDs: Fact sheet for public health personnel. Retrieved on 5/13/2016 at: www.cdc.gov/condomeffectiveness/brief.html

Centers for Disease Control and Prevention (CDC). (2014a). Compendium of evidence-based interventions and best practices for HIV prevention. Retrieved on 5/13/2016 at: www.cdc.gov/hiv/prevention/research/compendium/index.html

Centers for Disease Control and Prevention (CDC). (2014b). Laboratory testing for the diagnosis of HIV infection: Updated recommendations. Retrieved on 5/13/2016 at: stacks.cdc.gov/view/cdc/23447

Centers for Disease Control and Prevention (CDC). (2015a). Today's HIV/AIDS epidemic. Retrieved on 5/13/2016 at: www.cdc.gov/nchhstp/newsroom/docs/HIVFactSheets/TodaysEpidemic-508.pdf

Centers for Disease Control and Prevention (CDC). (2015b). *HIV in the United States: At a glance*. Retrieved on 5/31/6102: at www.cdc.gov/hiv/statistics/basics/ataglance.html

Centers for Disease Control and Prevention (CDC). (2015c). *CDC's HIV prevention progress in the United States*. Retrieved on 5/13/2016 at: www.cdc.gov/hiv/dhap/progress/index.html

Centers for Disease Control and Prevention (CDC). (2015d). HIV and injection drug use in the United States. Retrieved on 5/31/6102: www.cdc.gov/hiv/riskbehaviors/idu.html

Centers for Disease Control and Prevention (CDC). (2015e). *Occupational HIV transmission and prevention among health care workers*. Retrieved on 5/13/2016 at: www.cdc.gov/hiv/workplace/occupational.html

Centers for Disease Control and Prevention (CDC). (2015f). HIV testing. Retrieved on 5/31/6102 at: www.cdc.gov/hiv/testing/index.html

Chambers, L., Rueda, S., Baker, N., et al. (2015). Stigma, HIV and health: A qualitative synthesis. BMC Public Health, 15, 848, 1–17.Cherin, P., Marie, I., Michallet, M., et al. (2016). Management of adverse events in the treatment of patients with immunoglobulin therapy: A review of evidence. Autoimmunity Reviews, 15, 71–81.Costa-Carvalho, B., Grumach, A., Franco, J., et al. (2014). Attending to warning signs of primary immunodeficiency diseases across the range of clinical practice. Journal of Clinical Immunology, 34(1), 10–22.

**DeVita, V. T., Jr., Hellman, S., & Rosenberg, S. (Eds.). (1993). AIDS: Etiology, diagnosis, treatment, and prevention (4th ed.). Philadelphia: Lippincott Williams & Wilkins.

Fauci, A., & Marston, H. (2015). Toward an HIV vaccine: A scientific journey. Science, 349(6246), 386–387.

Fierz, K., Nicca, D., & Spirig, R. (2013). Perceived HIV symptom manageability: Synthesis of a new use for a known concept. Journal of Advanced Nursing, 69(1), 229–241.

Goovaerts, O., Jennes, W., Massinga-Loembé, M., et al. (2015). Lower pre-treatment T cell activation in early- and late-onset tuberculosis-associated immune reconstitution inflammatory syndrome. PLoS ONE, 10(7), e0133924.

Gornalusse, G., Mummidi, S., Gaitan, A., et al. (2015). Epigenetic mechanisms, T-cell activation, and CCR5 genetics interact to regulate T-cell expression of CCR5, the major HIV-1 coreceptor. Proceedings of the National Academy of Sciences of the United States of America, 112(34), E4762–E4771.

Hernandez-Trujillo, H., Orange, J., Roy, J., et al. (2015). Validity of primary immunodeficiency disease diagnoses in United States Medicaid data. Journal of Clinical Immunology, 35(6), 566–572.

HIV.gov. (2021). Global HIV AIDS organization. Retrieved on 26/6,2022, at: https://www.hiv.gov/federal-response/pepfar-global-aids/global-hiv-aids-organizations.

HIV/AIDS ACT 2017, Gazette of India Extraordinary Part II, Section I, Ministry of Law and Justice, NewDelhi, Retrieved on April 7th, 2018, at: http://naco.gov.in/hivaids-act-2017.

HIV Sentinel Surveillance Report 2016–17. Retrieved on 25th April, 2018, at: http://www.aidsdatahub.org/sites/default/files/publication/India_HSS_2016-17

Indian Nursing Council (2006). Ethical guidelines for biomedical research on human subjects, New Delhi.

Johnson, M. J., & Amella, E. J. (2013). Isolation of lesbian, gay, bisexual and transgender youth: A dimensional concept analysis. Journal of Advanced Nursing, 70(3), 523–532.

Kuhar, D., Henderson, D., Struble, K. et al. (2013). Updated US Public Health Service guidelines for the management of occupational exposures to human immunodeficiency virus and recommendations for postexposure prophylaxis. Infection Control and Hospital Epidemiology, 34(9), 875–892.

Lehman, H., Hernandez-Trujillo, V., & Ballow, M. (2015). Brief review: Diagnosing primary immunodeficiency: A practical approach for the non-immunologist. Current Medical Research & Opinion, 31(4), 697–706.

Li, L., Comulada, W.S., Wu, Z., et al. (2011). Providers HIV avoidance and attitude and patient satisfaction. Health Connection, 16, 105–112.

National AIDS Control Organization (NACO). National AIDS control program. Retrieved on April 7th, 2018, at: http://naco.gov.in/nacp

National Cancer Institute (NCI). (2015). AIDS-related lymphoma treatment. Retrieved on 5/31/2016 at: www.cancer.gov/types/lymphoma/patient/aids-related-treatment-pdq

National AIDS Control Organization (NACO). (2016). National guidelines for counselling and testing services. Retrieved on 26/6/2022, at: http://naco.gov.in/sites/default/files/National%20HIV%20Counselling%20%26%20Testing%20Services%20Guideline%2C%20Dec%202016.pdf.

National AIDS Control Organization, ICMR, NIMS, Ministry of Health and Family Welfare, Government of India. (2021). India HIV estimates. Technical brief (2020). Retrieved from: http://naco.gov.in/sites/default/files/India%20HIV%20Estimates%202020__Web_Version_0.pdf.

National Guidelines for HIV Care and Treatment. (2021). Retrieved on 26/6/2022 at: http://naco.gov.in/sites/default/files/National_Guidelines_for_HIV_Care_and_Treatment_2021.pdf.

National Institute on Aging (NIA). (2015). HIV, AIDS, and older people. Retrieved on 5/11/2016: www.nia.nih.gov/health/publication/hiv-aids-and-older-people

National Institute of Allergies and Infectious Diseases (NIAID). (2015). Types of primary immune deficiency disorders. Retrieved on 5/10/2016 at: www.niaid.nih.gov/topics/immuneDeficiency/Pages/majorPIDDs.aspx.

National Strategic Plan for Control of HIV/AIDS and STI 2017–2024. Retrieved on April 7th, 2018, at: http://naco.gov.in/national-strategic-plan-hivaids-and-sti-2017-24

Nicholas, P., Corless, I., & Evans, L. (2014). Peripheral neuropathy in HIV: An analysis of evidence-based approaches. Journal of the Association of Nurses in AIDS Care, 25(4), 318–29.

Panel on Opportunistic Infections in HIV-Infected Adults and Adolescents (OI-Panel). (2015). Guidelines for the prevention and treatment of opportunistic infections in HIV-infected adults and adolescents: recommendations from the Centers for Disease Control and Prevention, the National Institutes of Health, and the HIV Medicine Association of the Infectious Diseases Society of America (OI-Panel). Retrieved on 5/12/16 at: aidsinfo.nih.gov/contentfiles/lvguidelines/adult_oi.pdf

Perazzo, J. D., Webel, A. R., McGough, E., et al. (2018). People living with HIV: Implications for rehabilitation nurses. Rehabilitation Nursing, 43(3), 167–173.

Priya, N. L., Krishnan, K. U., Jayalakshmi, G., Vasanthi, S. (2015). An analysis of multimodal occupational exposure leading to blood borne infections among health care workers. Indian Journal of Pathology and Microbiology, 58, 66–68.

*Schnall, R., Wantland, D., Velez, O., et al. (2014). Feasibility testing of a web-based symptom self-management system for persons living with HIV. Journal of the Association of Nurses in AIDS Care, 25(4), 364–371.

Selik, R., Mokotoff, E., Branson, B., et al. (2014). Revised surveillance case definition for HIV infection—United States, 2014. Morbidity and Mortality Weekly Report, 63(RR03), 1–10.

Sharma, M., & Walmsley, S. (2015) Contraceptive options for HIV-positive women: Making evidence-based patient centered decisions. HIV Medicine, 16(6), 329–336.

*Tillman, J. L., & Mark, H. D. (2015). HIV and STI testing in older adults: An integrative review. Journal of Clinical Nursing. 24(15/16), 2074–2095.

US Public Health Service. (2014). Preexposure prophylaxis for the prevention of HIV infection in the United States: Clinical practice guideline. Retrieved on 5/11/2016: www.cdc.gov/hiv/pdf/prepguidelines2014.pdf

Vanham, G., Buvé, A., Florence, E., et al. (2014). What is the significance of post treatment control of HIV infection vis-à-vis functional cure? AIDS, 28(4), 603–605.
White House. (2015). National HIV/AIDS strategy for the United States: Updated to 2020. Retrieved on 5/11/2016 at: www.aids.gov/federal-resources/national-hiv-aids-strategy/nhas-update.pdf
Wichinski, K. (2015). Providing culturally proficient care for transgender. Nursing, 45(2), 58–63.
World Health Organization (WHO). (2015a). HIV/AIDS: Fact sheet N°360. Retrieved on 8/8/6102 at: www.who.int/mediacentre/factsheets/fs360/en/
World Health Organization (WHO). (2015b). Global summary of the AIDS epidemic/2014. Retrieved on 8/8/2016 at: www.who.int/hiv/data/epi_core_july2015.png
Younger, E., Epland, K., Zampelli, A., et al. (2015). Primary immunodeficiency diseases: A primer for PCPs. The Nurse Practitioner. 40(2), 1–7.

Resources

AIDS Community Research Initiative of America (ACRIA), www.acria.org
AIDS Education and Training Centers (AETCs) Program (regional, national, and international training opportunities), www.aidsetc.org
AIDSinfoglossary 8th edition. https://aidsinfo.nih.gov/contentfiles/glossaryhivrelatedterms_english.pdf
AIDS vaccines, http://www.avac.org/prevention-option/aids-vaccines
American Red Cross, www.redcross.org
Antiretroviral medication information websites: www.AIDSmeds.com; www.projectinform.org; www.sfaf.org; hivinsite.ucsf.edu/; www.amfAR.org; www.natap.org; www.thebody.com
ASHA Foundation, http://www.ashaf.org/
Care and support centres for HIV positives, naco.gov.in/care-and-support-centres-India HIV AIDS alliance, http://www.allianceindia.org
Centers for Disease Control and Prevention, HIV/AIDS Prevention Research Synthesis Project, http://www.cdc.gov/hiv/dhap/prb/prs/
Desire society–caring for children with AIDS, http://www.desiresociety.org/
Gay Men's Health Crisis Network (GMHC), www.gmhc.org.
Harm Reduction Coalition, http://harmreduction.org/about-us/
Health Resources and Service Administration (HRSA), National Clinician's Postexposure Prophylaxis Hotline (health care providers only), 1-888-HIV-4911
Health Resources and Service Administration (HRSA), National HIV Telephone Consultation Service, 1-800-933-3413
Indian Network for People Living with HIV/AIDS (INP+), inpplus@vsnl.com
International AIDS Vaccine Initiative (AVI), www.iavi.org
International Partnership for Microbicides, www.ipmglobal.org
National Institutes of Health, HIV/AIDS Treatment, Prevention, and Research, www.aidsinfo.nih.gov
National Pediatric and Family HIV Resource Center, www.womenchildrenhiv.org
Office of Minority Health Resource Center, http://www.minorityhealth.hhs.gov/omh/browse.aspx?lvl=4&lvlid=21
Pharmaceutical Research and Manufacturers of America (PhRMA), http://www.phrma.org/phrmapedia/search?search_api_ views_fulltext=HIV
POZ, Health, Life, & HIV. Published by Smart+Strong, 500 Fifth Avenue, Suite 320, New York, NY 10110, http://www.poz.com/
Saathi, www.saathii.org/

CHAPTER 56

Assessment and Management of Patients with Allergic Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Explain the physiologic events involved with allergic reactions.
2. Describe the types of hypersensitivity.
3. Use appropriate parameters for assessment of the status of patients with allergic disorders.
4. Describe the pathophysiologic changes, clinical manifestations, and management of patients with allergic disorders.
5. Specify measures to prevent and manage anaphylaxis.
6. Use the nursing process as a framework for care of the patient with allergic rhinitis.
7. Discuss the different allergic disorders according to type.

GLOSSARY

allergen: substance that causes manifestations of allergy
allergy: inappropriate and often harmful immune system response to substances that are normally harmless
anaphylaxis: rapid clinical response to an immediate immunologic reaction between a specific antigen and antibody
angioneurotic edema: condition characterized by urticaria and diffuse swelling of the deeper layers of the skin (i.e., angioedema)
antibody: protein substance developed by the body in response to and interacting with a specific antigen
antigen: substance that induces the production of antibodies
antihistamine: medication that opposes the action of histamine
atopic dermatitis: type I hypersensitivity involving inflammation of the skin evidenced by itching, redness, and a variety of skin lesions
atopy: term often used to describe immunoglobulin E–mediated diseases (i.e., atopic dermatitis, asthma, and allergic rhinitis) with a genetic component
B cells: lymphocyte cells that are important in producing circulating antibodies
bradykinin: a substance that stimulates nerve fibers and causes pain
eosinophil: granular leukocyte
erythema: diffuse redness of the skin
hapten: incomplete antigen
histamine: substance in the body that causes increased gastric secretion, dilation of capillaries, and constriction of the bronchial smooth muscle
hypersensitivity: abnormal heightened reaction to a stimulus of any kind
immunoglobulins: a family of closely related proteins capable of acting as antibodies
leukotrienes: a group of chemical mediators that initiate the inflammatory response
mast cells: connective tissue cells that contain heparin and histamine in their granules
prostaglandins: unsaturated fatty acids that have a wide assortment of biologic activity
serotonin: chemical mediator that acts as a potent vasoconstrictor and bronchoconstrictor
T cells: lymphocyte cells that can cause graft rejection, kill foreign cells, or suppress production of antibodies
urticaria: hives

Introduction

The human body is bombarded by a host of potential invaders—allergens as well as microbial organisms—that constantly threaten its defenses. After penetrating those defenses, these allergens and organisms, if allowed to continue unimpeded, disrupt the body's enzyme systems and destroy its vital tissues. To protect against these agents, the body is equipped with an elaborate defense system.

The epithelial cells that coat the skin and make up the lining of the respiratory, gastrointestinal, and genitourinary tracts provide the first line of defense against microbial invaders. The structure and continuity of these surfaces and their resistance to penetration are initial deterrents to invaders.

One of the most effective defense mechanisms is the body's capacity to equip itself rapidly with antibodies individually designed to meet each new invader—namely, specific protein antigens. Antibodies react with antigens in a variety of ways: (1) by coating the antigens' surfaces if they are particular substances, (2) by neutralizing the antigens if they are toxins, and (3) by precipitating the antigens out of solution if they are dissolved. The antibodies prepare the antigens so that the phagocytic cells of the blood and the tissues can dispose of them. However, although this system is normally protective, in some cases the body produces inappropriate or exaggerated responses to specific antigens, and the result is an allergic or hypersensitivity disorder.

ALLERGIC ASSESSMENT

Physiologic Overview

An allergic reaction is a manifestation of tissue injury resulting from interaction between an antigen and an antibody. Allergy is an inappropriate and often harmful response of the immune system to normally harmless substances, called **allergens** (e.g., dust, weeds, pollen, dander). Chemical mediators released in allergic reactions may produce symptoms that range from mild to life-threatening.

In allergic reactions, the body encounters allergens that are types of **antigens**, usually proteins that the body's defenses recognize as foreign, and a series of events occurs in an attempt to render the invaders harmless, destroy them, and remove them from the body. When lymphocytes respond to the antigens,

antibodies (protein substances that protect against antigens) are produced.

Antibodies combine with antigens in a special way, which has been likened to keys fitting into a lock. Antigens (the keys) fit only certain antibodies (the locks). Hence, the term *specificity* refers to the specific reaction of an antibody to an antigen. There are many variations and complexities in these patterns.

Function of Immunoglobulins

Antibodies that are formed by lymphocytes and plasma cells in response to an immunogenic stimulus constitute a group of serum proteins called immunoglobulins. Grouped into five classes (IgG, IgA, IgM, IgD, and IgE), immunoglobulins can be found in the lymph nodes, tonsils, appendix, and Peyer patches of the intestinal tract or circulating in the blood and lymph. These antibodies are capable of binding with a wide variety of antigens. Immunoglobulins of the IgE class are involved in allergic disorders and some parasitic infections. IgE-producing cells are located in the respiratory and intestinal mucosa. Two or more IgE molecules bind together to an allergen and trigger mast cells or basophils to release chemical mediators, such as histamine, serotonin, kinins, slow-reacting substances of anaphylaxis, and the neutrophil factor, which produces allergic skin reactions, asthma, and hay fever. Atopy refers to IgE-mediated diseases, such as allergic rhinitis, that have a genetic component. See Chapter 54 for more information on immunoglobulins.

Role of B Cells

B cells, or B lymphocytes, are programmed to produce one specific antibody. On encountering a specific antigen, B cells stimulate production of plasma cells, the site of antibody production. The result is the outpouring of antibodies for the purpose of destroying and removing the antigens.

Role of T Cells

T cells, or T lymphocytes, assist the B cells. T cells secrete substances that direct the flow of cell activity, destroy target cells, and stimulate the macrophages. The macrophages present the antigens to the T cells and initiate the immune response. They also digest antigens and assist in removing cells and other debris. Unlike a specific antibody, a T cell does not bind free antigens.

Function of Antigens

Antigens are divided into two groups: complete protein antigens and low–molecular-weight substances. Complete protein antigens, such as animal dander, pollen, and horse serum, stimulate a complete humoral response. See Chapter 54 for a discussion of humoral immunity. Low–molecular-weight substances, such as medications, function as **haptens** (incomplete antigens), binding to tissue or serum proteins to produce a carrier complex that initiates an antibody response. In an allergic reaction, the production of antibodies requires active communication between cells. When the allergen is absorbed through the respiratory tract, gastrointestinal tract, or skin, allergen sensitization occurs. Macrophages process the antigen and present it to the appropriate cells. These cells mature into allergen-specific secreting plasma cells that synthesize and secrete antigen-specific antibodies.

Function of Chemical Mediators

Mast cells, which are located in the skin and mucous membranes, play a major role in IgE-mediated immediate hypersensitivity. When mast cells are stimulated by antigens, powerful chemical mediators are released, causing a sequence of physiologic events that result in symptoms of immediate hypersensitivity (see Fig. 56-1). There are two types of chemical mediators: primary and secondary. Primary mediators are preformed and are found in mast cells or basophils. Secondary mediators are inactive precursors that are formed or released in response to primary mediators. Table 56-1 summarizes the actions of primary and secondary chemical mediators.

Primary Mediators

Histamine

Histamine, which is released by mast cells, plays an important role in the immune response. It is the first chemical mediator to be released in immune and inflammatory responses. It is synthesized and stored in high concentrations in body tissues exposed to environmental substances (Frandsen & Pennington, 2014). Histamine's effects peak 5 to 10 minutes after antigen contact and include the following: erythema; localized edema in the form of wheals; pruritus; contraction of bronchial smooth muscle, resulting in wheezing and bronchospasm; dilation of small venules and constriction of larger vessels; and increased secretion of gastric and mucosal cells, resulting in diarrhea (Abbas, Lichtman, & Pillai, 2014); (Fleisher, Shearer, Schroeder, et al., 2013). Histamine action results from stimulation of histamine-1 (H_1) and histamine-2 (H_2) receptors. H_1 receptors are found predominantly on bronchiolar and vascular smooth muscle cells; H_2 receptors are found on gastric parietal cells.

Certain medications are categorized by their action at these receptors. Diphenhydramine (Benadryl) is an example of an

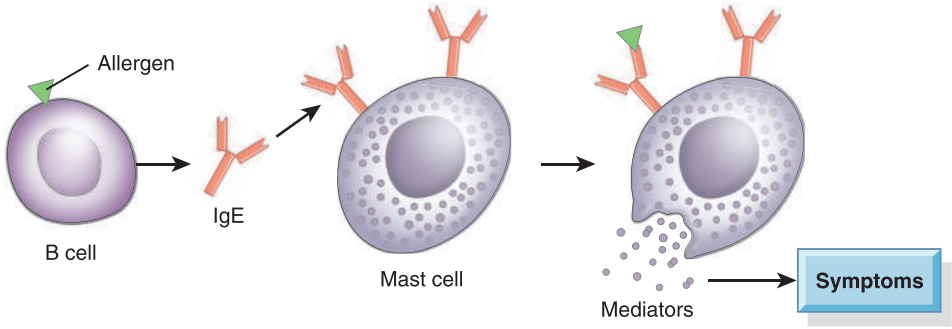


Figure 56-1 • Allergen triggers the B cell to make immunoglobulin E (IgE) antibody, which attaches to the mast cell. When that allergen reappears, it binds to the IgE and triggers the mast cell to release its chemicals. Courtesy of the U.S. Department of Health and Human Services, National Institutes of Health.

TABLE 56-1 Chemical Mediators of Hypersensitivity

Mediators	Action
Primary Mediators	
Preformed and Found in Mast Cells or Basophils	
Histamine (preformed in mast cells)	Vasodilation
	Smooth muscle contraction, increased vascular permeability, increased mucus secretions
Eosinophil chemotactic factor of anaphylaxis (preformed in mast cells)	Attracts eosinophils
Platelet-activating factor (requires synthesis by mast cells, neutrophils, and macrophages)	Smooth muscle contraction
	Incites platelets to aggregate and release serotonin and histamine
Prostaglandins (chemically derived from arachidonic acid; require synthesis by cells)	D and F series → bronchoconstriction
	E series → bronchodilation
	D, E, and F series → vasodilation
Basophil kallikrein (preformed in mast cells)	Frees bradykinin, which causes bronchoconstriction, vasodilation, and nerve stimulation
Secondary Mediators	
Inactive Precursors Formed or Released in Response to Primary Mediators	
Bradykinin (derived from precursor kininogen)	Smooth muscle contraction, increased vascular permeability, stimulates pain receptors, increased mucus production
Serotonin (preformed in platelets)	Smooth muscle contraction, increased vascular permeability
Heparin (preformed in mast cells)	Anticoagulant
Leukotrienes (derived from arachidonic acid and activated by mast cell degranulation) C, D, and E or slow-reacting substance of anaphylaxis	Smooth muscle contraction, increased vascular permeability

Adapted from Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

antihistamine, a medication that displays an affinity for H_1 receptors. Cimetidine (Tagamet) and ranitidine (Zantac) target H_2 receptors to inhibit gastric secretions in peptic ulcer disease.

Eosinophil Chemotactic Factor of Anaphylaxis

Eosinophil chemotactic factor of anaphylaxis affects the movement of **eosinophils** (granular leukocytes) to the site of allergens. It is preformed in the mast cells and is released from disrupted mast cells.

Platelet-Activating Factor

Platelet-activating factor is responsible for initiating platelet aggregation and leukocyte infiltration at sites of immediate hypersensitivity reactions. It also causes vasodilation, bronchoconstriction, and increased vascular permeability (Frandsen & Pennington, 2014).

Prostaglandins

Prostaglandins produce smooth muscle contraction as well as vasodilation and increased capillary permeability. They sensitize pain receptors and increase the pain associated with inflammation. In addition, prostaglandins induce inflammation and enhance the effects of mediators of inflammatory response. Local manifestations include erythema, heat, and edema (Frandsen & Pennington, 2014).

Secondary Mediators

Leukotrienes

Leukotrienes are chemical mediators that initiate the inflammatory response. Many manifestations of inflammation can be attributed in part to leukotrienes. In addition, leukotrienes cause smooth muscle contraction, bronchial constriction, mucus secretion in the airways, and the typical wheal-and-flare reactions of the skin. Compared with histamine, leukotrienes are 100 to 1000 times more potent in causing bronchospasm.

Bradykinin

Bradykinin is a substance that has the ability to cause increased vascular permeability, vasodilation, hypotension, and contraction of many types of smooth muscle, such as the bronchi. Increased permeability of the capillaries results in edema. Bradykinin stimulates nerve cell fibers and produces pain.

Serotonin

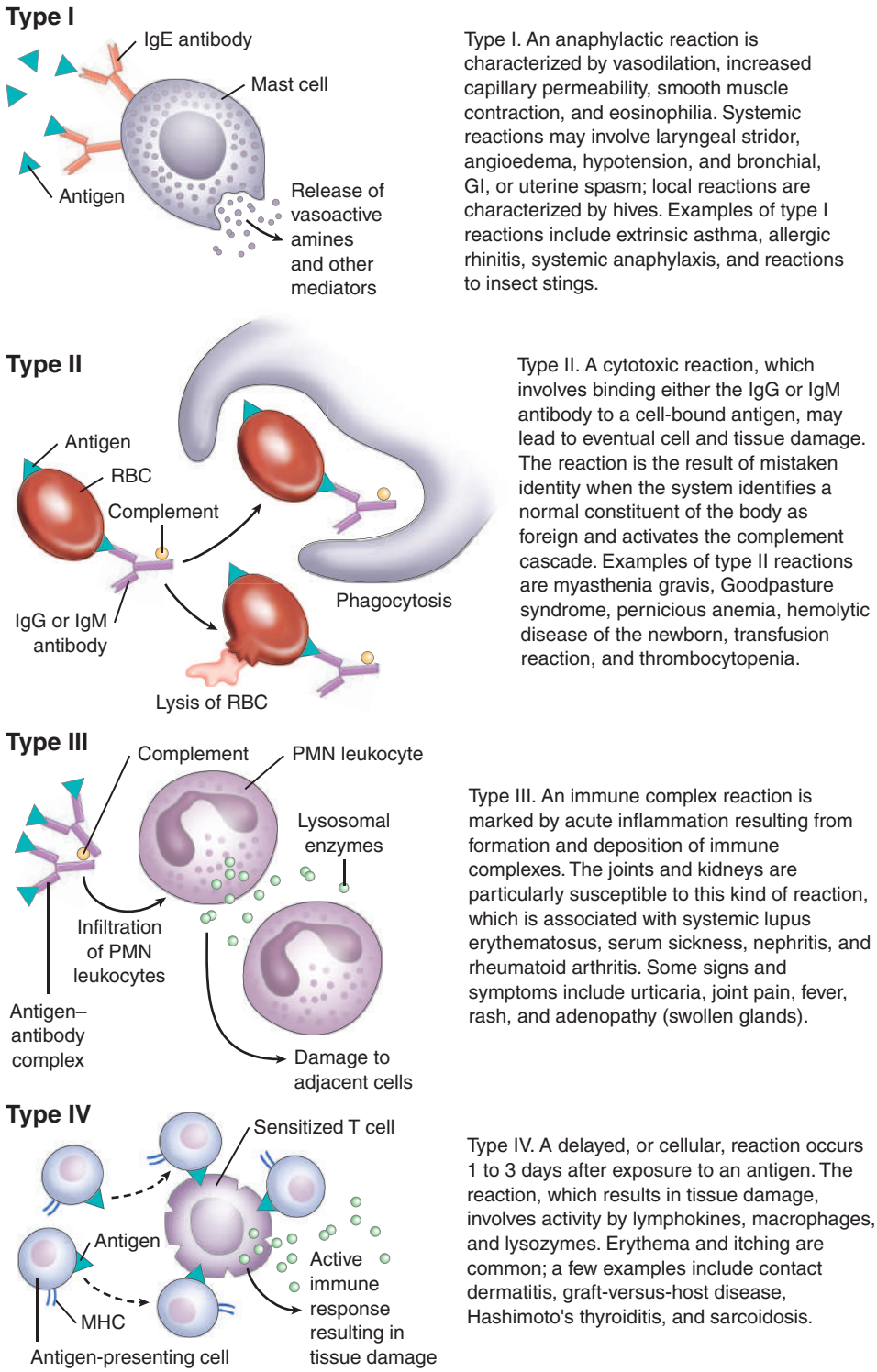
Serotonin acts as a potent vasoconstrictor and causes contraction of bronchial smooth muscle.

Hypersensitivity

Although the immune system defends the host against infections and foreign antigens, immune responses can themselves cause tissue injury and disease. Hypersensitivity is an excessive or aberrant immune response to any type of stimulus (Abbas et al., 2014). It usually does not occur with the first exposure to an allergen. Rather, the reaction follows a re-exposure after sensitization, or buildup of antibodies, in a predisposed person. Injurious or pathologic immune reactions are classed as hypersensitivity reactions. To promote understanding of the immunopathogenesis of disease, hypersensitivity reactions have been classified into four specific types of reactions (see Fig. 56-2). Most allergic reactions are either type I or type IV hypersensitivity reactions.

Anaphylactic (Type I) Hypersensitivity

The most severe hypersensitivity reaction is anaphylaxis. An unanticipated severe allergic reaction that is rapid in onset, anaphylaxis is characterized by edema in many tissues, including the larynx, and is often accompanied by hypotension, bronchospasm, and cardiovascular collapse in severe cases. Type I or anaphylactic hypersensitivity is an immediate reaction beginning within minutes of exposure to an antigen. Primary chemical mediators are responsible for the symptoms of type I



Type I. An anaphylactic reaction is characterized by vasodilation, increased capillary permeability, smooth muscle contraction, and eosinophilia. Systemic reactions may involve laryngeal stridor, angioedema, hypotension, and bronchial, GI, or uterine spasm; local reactions are characterized by hives. Examples of type I reactions include extrinsic asthma, allergic rhinitis, systemic anaphylaxis, and reactions to insect stings.

Type II. A cytotoxic reaction, which involves binding either the IgG or IgM antibody to a cell-bound antigen, may lead to eventual cell and tissue damage. The reaction is the result of mistaken identity when the system identifies a normal constituent of the body as foreign and activates the complement cascade. Examples of type II reactions are myasthenia gravis, Goodpasture syndrome, pernicious anemia, hemolytic disease of the newborn, transfusion reaction, and thrombocytopenia.

Type III. An immune complex reaction is marked by acute inflammation resulting from formation and deposition of immune complexes. The joints and kidneys are particularly susceptible to this kind of reaction, which is associated with systemic lupus erythematosus, serum sickness, nephritis, and rheumatoid arthritis. Some signs and symptoms include urticaria, joint pain, fever, rash, and adenopathy (swollen glands).

Type IV. A delayed, or cellular, reaction occurs 1 to 3 days after exposure to an antigen. The reaction, which results in tissue damage, involves activity by lymphokines, macrophages, and lysozymes. Erythema and itching are common; a few examples include contact dermatitis, graft-versus-host disease, Hashimoto's thyroiditis, and sarcoidosis.

Figure 56-2 • Four types of hypersensitivity reactions. GI, gastrointestinal; Ig, immunoglobulin; PMN, polymorphonuclear; RBC, red blood cell.

hypersensitivity because of their effects on the skin, lungs, and gastrointestinal tract. If chemical mediators continue to be released, a delayed reaction may occur and may last for up to 24 hours.

Clinical symptoms are determined by the amount of the allergen, the amount of mediator released, the sensitivity of the target organ, and the route of allergen entry. Type I hypersensitivity reactions may include both local and systemic anaphylaxis.

Cytotoxic (Type II) Hypersensitivity

Type II, or cytotoxic, hypersensitivity occurs when the system mistakenly identifies a normal constituent of the body as foreign. This reaction may be the result of a cross-reacting antibody, possibly leading to cell and tissue damage.

Type II hypersensitivity reactions are associated with several disorders. For example, in myasthenia gravis, the body

mistakenly generates antibodies against normal nerve ending receptors. In Goodpasture syndrome, it generates antibodies against lung and renal tissue, producing lung damage and kidney injury (Grossman & Porth, 2014).

Immune Complex (Type III) Hypersensitivity

Type III, or immune complex, hypersensitivity involves immune complexes that are formed when antigens bind to antibodies. These complexes are cleared from the circulation by phagocytic action. If these type III complexes are deposited in tissues or vascular endothelium, two factors contribute to injury: the increased amount of circulating complexes and the presence of vasoactive amines. As a result, there is an increase in vascular permeability and tissue injury.

Delayed-Type (Type IV) Hypersensitivity

Type IV, or delayed-type, hypersensitivity (DTH), is an immune reaction in which T-cell–dependent macrophage activation and inflammation cause tissue injury. This type of reaction to the subcutaneous injection of antigen is often used as an assay for cell-mediated immunity (e.g., the purified protein derivative skin test for immunity to *Mycobacterium tuberculosis*) (Abbas et al., 2014).

Assessment

A comprehensive allergy history and a thorough physical examination provide useful data for the diagnosis and management of allergic disorders. An allergy assessment form is useful for obtaining and organizing pertinent information (see Chart 56-1).

The degree of difficulty and discomfort experienced by the patient because of allergic symptoms and the degree of improvement in those symptoms with and without treatment are assessed and documented. The relationship of symptoms to exposure to possible allergens is noted.

Diagnostic Evaluation

Diagnostic evaluation of the patient with allergic disorders commonly includes blood tests, smears of body secretions, skin tests, and the serum-specific IgE test (formerly known as radioallergosorbent test [RAST]). Results of laboratory blood studies provide supportive data for various diagnostic possibilities; however, they are not the major criteria for the diagnosis of allergic disease.

Complete Blood Count With Differential

The white blood cell (WBC) count is usually normal except with infection and inflammation (Pagana & Pagana, 2013). Eosinophils, which are granular leukocytes, normally make up 2% to 5% of the total number of WBCs. They can be found in blood, sputum, and nasal secretions. A level greater than 5% to 10% is considered abnormal and may be found in patients with allergic disorders (Fleisher et al., 2013).

Eosinophil Count

An actual count of eosinophils can be obtained from blood samples or smears of secretions. During symptomatic episodes, smears obtained from nasal secretions and sputum of patients with allergies usually reveal an increase in eosinophils, indicating an active allergic response (Fleisher et al., 2013).

Total Serum Immunoglobulin E Levels

High total serum IgE levels support the diagnosis of allergic disease. In the majority of cases, the antibody typically responsible for an allergic reaction belongs to the IgE isotype. Patients with this disorder are said to have an IgE-mediated allergic disease (Portnoy, 2015).

Skin Tests

Skin testing entails the intradermal injection or superficial application (epicutaneous) of solutions at several sites. Depending on the suspected cause of allergic signs and symptoms, many different solutions may be applied at separate sites. These solutions contain individual antigens representing an assortment of allergens most likely to be implicated in the patient's disease. Positive (wheal-and-flare) reactions are clinically significant when correlated with the history, physical findings, and results of other laboratory tests. Skin testing is considered the most accurate confirmation of allergy (Oppenheimer, Durham, Nelson, et al., 2014).

The results of skin tests complement the data obtained from the history. They indicate which of several antigens are most likely to provoke symptoms and indicate the intensity of the patient's sensitization. The dosage of the antigen (allergen) injected is also important. Most patients are hypersensitive to more than one allergen. Under testing conditions, they may not react (although they usually do) to the specific allergens that induce their attacks.

In cases of doubt about the validity of the skin tests, a serum-specific IgE test or a provocative challenge test may be performed. If a skin test is indicated, there is a reasonable suspicion that a specific allergen is producing symptoms in a patient with allergies. However, several precautionary steps must be observed before skin testing with allergens is performed:

- Testing is not performed during periods of bronchospasm.
- Epicutaneous tests (scratch or prick tests) are performed before other testing methods, in an effort to minimize the risk of systemic reaction.
- Emergency equipment must be readily available to treat anaphylaxis.

Types of Skin Tests

The methods of skin testing include prick skin tests, scratch tests, and intradermal skin testing (see Fig. 56-3). After negative prick or scratch tests, intradermal skin testing is performed with allergens that are suggested by the patient's history to be problematic. The back is the most suitable area of the body for skin testing because it permits the performance of many tests. A multitest applicator with multiple test heads is commercially available for simultaneous administration of antigens by multiple punctures at different sites. A negative response on a skin test cannot be interpreted as an absence of sensitivity to an allergen. Such a response may occur with insufficient sensitivity of the test or with the use of an inappropriate allergen in testing. Therefore, it is essential to observe the patient undergoing skin testing for an allergic reaction even if the previous response was negative.

Interpretation of Skin Test Results

Familiarity with and consistent use of a grading system are essential. The grading system used should be identified on a skin test record for later interpretation. A positive reaction, evidenced by the appearance of an urticarial wheal (round, reddened skin elevation) (see Fig. 56-4), localized erythema

Chart 56-1 ASSESSMENT

Allergy Assessment Form

Name _____ Age _____ Sex _____ Date _____

I. Chief complaint: _____

II. Present illness: _____

III. Collateral allergic symptoms: _____

Eyes: Pruritus _____ Burning _____ Lacrimation _____
Swelling _____ Injection _____ Discharge _____

Ears: Pruritus _____ Fullness _____ Popping _____
Frequent infections _____

Nose: Sneezing _____ Rhinorrhea _____ Obstruction _____
Pruritus _____ Mouth breathing _____
Purulent discharge _____

Throat: Soreness _____ Postnasal discharge _____
Palatal pruritus _____ Mucus in the morning _____

Chest: Cough _____ Pain _____ Wheezing _____
Sputum _____ Dyspnea _____
Color _____ Rest _____
Amount _____ Exertion _____

Skin: Dermatitis _____ Eczema _____ Urticaria _____

IV. Family allergies: _____

V. Previous allergic treatment or testing: _____

Prior skin testing: _____

Medications:

Antihistamines	Improved _____	Unimproved _____
Bronchodilators	Improved _____	Unimproved _____
Nose drops	Improved _____	Unimproved _____
Hyposensitization	Improved _____	Unimproved _____
Duration _____		
Antigens _____		
Reactions _____		
Antibiotics	Improved _____	Unimproved _____
Corticosteroids	Improved _____	Unimproved _____

VI. Physical agents and habits: _____

	Bothered by:	
Tobacco for _____ years	Alcohol _____	Air-conditioning _____
Cigarettes _____ packs/day	Heat _____	Muggy weather _____
Cigars _____ per day	Cold _____	Weather changes _____
Pipes _____ per day	Perfumes _____	Chemicals _____
Never smoked _____	Paints _____	Hair spray _____
Bothered by smoke _____	Insecticides _____	Newspapers _____
	Cosmetics _____	Latex _____

VII. When symptoms occur: _____

Time and circumstances of 1st episode: _____

Prior health: _____

Course of illness over decades: progressing _____ regressing _____

Time of year: _____ Exact dates: _____

Perennial _____
Seasonal _____
Seasonally exacerbated _____

Monthly variations (menses, occupation): _____

Time of week (weekends vs. weekdays): _____

Time of day or night: _____

After insect stings: _____

VIII. Where symptoms occur: _____

Living where at onset: _____

Living where since onset: _____

Effect of vacation or major geographic change: _____

Symptoms better indoors or outdoors: _____

Effect of school or work: _____

Effect of staying elsewhere nearby: _____

Effect of hospitalization: _____

Effect of specific environments: _____

Do symptoms occur around: _____

old leaves _____ hay _____ lakeside _____ barns _____
summer homes _____ damp basement _____ dry attic _____
lawn mowing _____ animals _____ other _____

(Continued)

(Continued)

Do symptoms occur after eating:
cheese _____ mushrooms _____ beer _____ melons _____
bananas _____ fish _____ nuts _____ citrus fruits _____
other foods (list) _____

Home: city _____ rural _____
house _____ age _____
apartment _____ basement _____ damp _____ dry _____
heating system _____
vacuum cleaner system _____ use of HEPA filter _____
pets (how long) _____ dog _____ cat _____ other _____

Bedroom:	Type	Age	Living room:	Type	Age
Pillow	_____	_____	Rug	_____	_____
Mattress	_____	_____	Matting	_____	_____
Blankets	_____	_____	Furniture	_____	_____
Quilts	_____	_____			
Furniture	_____	_____			

Anywhere in home symptoms are worse: _____

IX. What does patient think makes symptoms worse? _____
X. Under what circumstances is patient free of symptoms? _____
XI. Summary and additional comments: _____

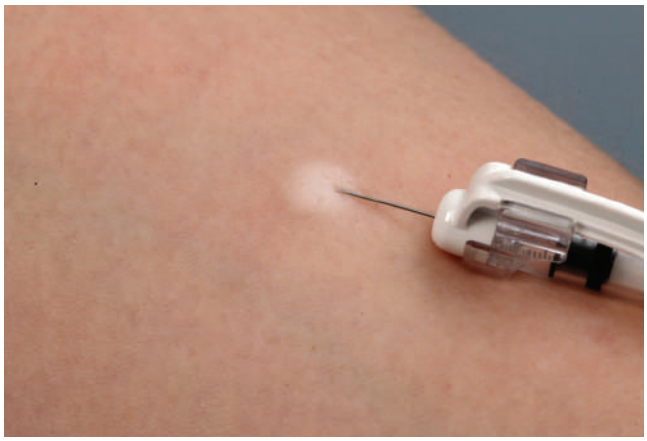


Figure 56-3 • Intradermal testing. A 0.5- or 1-mL sterile syringe with a 26/27-gauge intradermal needle is used to inject 0.02 to 0.03 mL of intradermal allergen. The needle is inserted with the bevel facing upward and the syringe parallel to the skin. The skin is penetrated superficially, and a small amount of the allergen solution is injected to create a bleb (raised area) approximately 5 mm in diameter. A separate sterile syringe and needle are used for each injection. From Taylor, C., Lillis C., LeMone, P., & Lynn, P. (2011). Fundamentals of nursing: The art and science of nursing care (7th ed.). Philadelphia, PA Lippincott Williams & Wilkins.

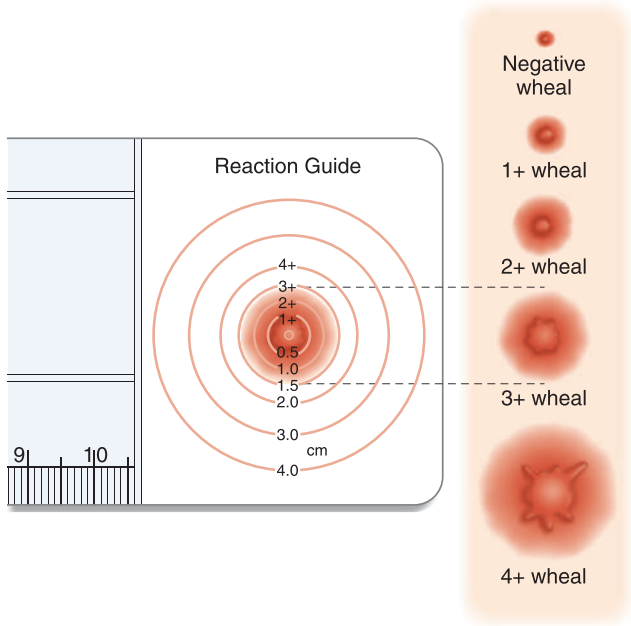


Figure 56-4 • Interpretation of reactions: Negative = wheal soft with minimal erythema; 1+ = wheal present (5 to 8 mm) with associated erythema; 2+ = wheal (7 to 10 mm) with associated erythema; 3+ = wheal (9 to 15 mm), slight pseudopodia possible with associated erythema; 4+ = wheal (12 mm+) with pseudopodia and diffuse erythema.

(diffuse redness) in the area of inoculation or contact, or pseudopodia (irregular projection at the end of a wheal) with associated erythema is considered indicative of sensitivity to the corresponding antigen. False-positive results may occur because of improper preparation or administration of allergen solutions.

Nursing Alert: Corticosteroids and antihistamines, including over-the-counter allergy medications, suppress skin test reactivity and should be stopped 48 to 96 hours before testing, depending on the duration of their activity. False-positive results may occur because of improper preparation or administration of allergen solutions.

Positive or negative skin tests are interpreted in the context of a patient's history, clinical signs, and exposure to allergens (Australasian Society of Clinical Immunology and Allergy [ASCIA], 2015). The following guidelines are used for the interpretation of skin test results:

- Skin tests are used most frequently with the diagnosis of allergic rhinitis (Baran, Ozcan, Selcuk, et al., 2014).
- Negative test results are helpful in ruling out food allergy.
- Positive skin tests correlate highly with food allergy (ASCIA, 2015).

The use of skin tests to diagnose immediate hypersensitivity to medications is limited, because metabolites of medications, not the medications themselves, are usually responsible for causing hypersensitivity.

Provocative Testing

Provocative testing involves the direct administration of the suspected allergen to the sensitive tissue, such as the conjunctiva, nasal or bronchial mucosa, or gastrointestinal tract (by ingestion of the allergen), with observation of target organ response. This type of testing is helpful in identifying clinically significant allergens in patients who have a large number of positive tests. Major disadvantages of this type of testing are the limitation of one antigen per session and the risk of producing severe symptoms, particularly bronchospasm, in patients with asthma.

Serum-Specific IgE Test

The serum-specific IgE test, formerly known as RAST, is an automated test performed on blood samples by a pathology laboratory. As the name suggests, it detects free antigen-specific IgE in serum as opposed to antigen-specific IgE bound to mast cells in the skin (ASCIA, 2015); (Portnoy, 2015). The advantages of this test over other tests include decreased risk of systemic reaction, stability of antigens, and lack of dependence on skin reactivity modified by medications. The major disadvantages include limited allergen selection and reduced sensitivity compared with intradermal skin tests, lack of immediate results, and higher cost (ASCIA, 2015).

ALLERGIC DISORDERS

There are two types of IgE-mediated allergic reactions: atopic and nonatopic disorders. Although the underlying immunologic reactions of the two types of disorders are the same, the predisposing factors and manifestations are different. Atopy is defined as the genetic predisposition to mount an IgE response to inhaled or ingested innocuous proteins (Fleisher et al., 2013). Atopic diseases consist of asthma, allergic rhinitis, and atopic dermatitis. All share a common pathogenesis, mediated by IgE, and are frequently present together in the same individual and in families. The nonatopic disorders lack the genetic component and organ specificity of the atopic disorders (Fleisher et al., 2013). Latex allergy (see later discussion) can present as an IgE-mediated anaphylaxis, type I reaction, or a type IV hypersensitivity referred to as contact dermatitis (American Academy of Allergy, Asthma, & Immunology [AAAAI], 2015); (Fleisher et al., 2013); (Habif, 2016).

Anaphylaxis

Anaphylaxis is a clinical response to an immediate (type I hypersensitivity) immunologic reaction between a specific antigen and an antibody. The reaction results from a rapid release of IgE-mediated chemicals, which can induce a severe, life-threatening reaction (Abbas et al., 2014).

Pathophysiology

Anaphylaxis is a type I IgE allergic reaction to an antigen, a foreign substance that has entered the body (Frandsen & Pennington, 2014). It is caused by the cross-links of an allergen with allergen-specific IgE antibodies found on the surface membrane of mast cells and basophils, leading to cellular degranulation. The subsequent release of histamine and other bioactive mediators causes activation of platelets, eosinophils, and neutrophils. Histamine, prostaglandins, and inflammatory leukotrienes are potent vasoactive mediators that are implicated in the vascular permeability changes, flushing, urticaria, angioedema, hypotension, and bronchoconstriction that characterize anaphylaxis. Smooth muscle spasm, bronchospasm, mucosal edema and inflammation, and increased capillary permeability result. Symptoms of anaphylaxis are sudden in onset and progress in severity over minutes to hours (Campbell, Li, Nicklas, et al., 2014).

Closely resembling anaphylaxis is an anaphylactoid reaction, which is caused by the release of mast cell and basophil mediators triggered by non–immunoglobulin E (IgE)-mediated events. This nonallergenic anaphylaxis reaction may occur with medications, food, exercise, or cytotoxic antibody transfusions. The reaction may be local or systemic. Local reactions usually involve urticaria and angioedema at the site of the antigen exposure. Although possibly severe, nonallergenic anaphylaxis reactions are rarely fatal. Systemic reactions occur within about 30 minutes after exposure and involve cardiovascular, respiratory, gastrointestinal, and integumentary organ systems. For the most part, the treatment of nonallergenic anaphylaxis reaction is identical to that of anaphylaxis.

Common causes of anaphylaxis are listed in Chart 56-2. Antibiotics and radiocontrast agents cause the most serious anaphylactic reactions. Penicillin is the most common medication to cause anaphylaxis. In a study of an outpatient adult population, the prevalence of penicillin allergy was found to be 12% (Albin & Agarwal, 2014). However, only 6% of these patients were referred to an allergist for testing. Patients with reported penicillin allergy who were evaluated with skin testing experienced decreased use of broad spectrum antibiotics and fewer anaphylactic reactions (Albin & Agarwal, 2014).

Clinical Manifestations

Anaphylactic reactions produce a clinical syndrome that affects multiple organ systems. Reactions may be categorized as mild, moderate, or severe. The time from the exposure to the antigen to the onset of symptoms is a good indicator of the severity of the reaction—the faster the onset, the more severe the reaction. The severity of previous reactions does not determine the severity of subsequent reactions, which could be the same or more or less

Chart 56-2

Common Causes of Anaphylaxis

Foods

Peanuts, tree nuts (e.g., walnuts, pecans, cashews, almonds), shellfish (e.g., shrimp, lobster, crab), fish, milk, eggs, soy, wheat

Medications

Antibiotics, especially penicillin and sulfa antibiotics, allopurinol, radiocontrast agents, anesthetic agents (lidocaine, procaine), vaccines, hormones (insulin, vasopressin, adrenocorticotropic hormone), aspirin, nonsteroidal anti-inflammatory drugs

Other Pharmaceutical/Biologic Agents

Animal serums (tetanus antitoxin, snake venom antitoxin, rabies antitoxin), antigens used in skin testing

Insect Stings

Bees, wasps, hornets, yellow jackets, ants (including fire ants)

Latex

Medical and nonmedical products containing latex

severe. The severity depends on the degree of allergy and the dose of allergen exposure (Campbell et al., 2014).

Mild systemic reactions consist of peripheral tingling and a sensation of warmth, possibly accompanied by a sensation of fullness in the mouth and throat. Nasal congestion, periorbital swelling, pruritus, sneezing, and tearing of the eyes can also be expected. The onset of symptoms begins within the first 2 hours after the exposure.

Moderate systemic reactions may include flushing, warmth, anxiety, and itching in addition to any of the milder symptoms. More serious reactions include bronchospasm and edema of the airways or larynx with dyspnea, cough, and wheezing. The onset of symptoms is the same as for a mild reaction.

Severe systemic reactions have an abrupt onset with the same signs and symptoms described previously. These symptoms progress rapidly to bronchospasm, laryngeal edema, severe dyspnea, cyanosis, and hypotension. Dysphagia (difficulty swallowing), abdominal cramping, vomiting, diarrhea, and seizures can also occur. Cardiac arrest and coma may follow. Severe reactions are also referred to as anaphylactic shock (see Chapter 8).

Prevention

Strict avoidance of potential allergens is an important preventive measure for the patient at risk for anaphylaxis. Those at risk for anaphylaxis from insect stings should avoid areas populated by insects and should use appropriate clothing, insect repellent, and caution to avoid further stings.

If avoidance of exposure to allergens is impossible, an auto-injector system for epinephrine will be prescribed. The patient should be instructed to carry and administer epinephrine to prevent an anaphylactic reaction in the event of exposure to the allergen. People who are sensitive to insect bites and stings, those who have experienced food or medication reactions, and those who have experienced idiopathic or exercise-induced anaphylactic reactions should always carry an emergency kit that contains epinephrine. The EpiPen and Auvi-Q are auto-injection devices that are commercially available for first aid that deliver premeasured doses of epinephrine (Comerford, 2015); (Frandsen & Pennington, 2014). The auto-injector system requires no preparation, and the self-administration technique is not complicated. The patient must be given an opportunity to demonstrate the correct technique for use; an EpiPen training device can be used for educating about the correct technique. Verbal and written information about the emergency kit, as well as strategies to avoid exposure to threatening allergens, must also be provided.

Screening for allergies before a medication is prescribed or first given is an important preventive measure. A careful history of any sensitivity to suspected antigens must be obtained before administering any medication, particularly in parenteral form, because this route is associated with the most severe anaphylaxis. Nurses caring for patients in any setting (hospital, home, outpatient diagnostic testing sites, long-term care facilities) must assess patients' risks for anaphylactic reactions. Patients are asked about previous exposure to contrast agents used for diagnostic tests and any allergic reactions, as well as reactions to any medications, foods, insect stings, and latex. People who are predisposed to anaphylaxis should wear medical identification such as a bracelet or necklace, which names allergies to medications, food, and other substances.

People who are allergic to insect venom may require venom immunotherapy, which is used as a control measure and not a cure. The most common serious allergic reactions to insect stings are from the Hymenoptera family, which includes bees, ants, wasps, and yellow jackets (Perez-Riverol, Justo-Jacomini, de Lima Zollner, et al., 2015). Venom is an effective treatment for people with systemic reactions to an insect sting. It reduces the systemic reaction, reduces the risk of future large local reactions, and improves quality of life (Ludman & Boyle, 2015).

Insulin-allergic patients with diabetes and those who are allergic to penicillin may require desensitization. Desensitization is based on controlled anaphylaxis, with a gradual release of mediators. Patients who undergo desensitization are cautioned to avoid lapses in therapy, because this may lead to the reappearance of the allergic reaction when the use of the medication is resumed.

Medical Management

Management depends on the severity of the reaction. Initially, respiratory and cardiovascular functions are evaluated. If the patient is in cardiac arrest, cardiopulmonary resuscitation (CPR) is instituted (Link, Berkow, Kudenchuk, et al., 2015). Supplemental oxygen is provided during CPR or if the patient is cyanotic, dyspneic, or wheezing. Epinephrine, in a 1:1000 dilution, is given subcutaneously in the upper extremity or thigh and may be followed by a continuous intravenous infusion. Most adverse events associated with administration of epinephrine (i.e., adrenaline) occur when the dose is excessive or is given intravenously. Patients at risk for adverse effects include older patients and those with hypertension, arteriopathies, or known ischemic heart disease.

Antihistamines and corticosteroids should not be given in place of epinephrine. However, they may also be given as adjunct therapy (Campbell et al., 2014).

Intravenous fluids (e.g., normal saline solution), volume expanders, and vasopressor agents are given to maintain blood pressure and normal hemodynamic status. In patients with episodes of bronchospasm or a history of bronchial asthma or chronic obstructive pulmonary disease, aminophylline and corticosteroids may also be given to improve airway patency and function. (See Chapter 8 for management of anaphylactic shock.)

Patients who have experienced anaphylactic reactions and received epinephrine should be transported to the local emergency department (ED) for observation and monitoring because of the risk for a "rebound" or delayed reaction 4 to 8 hours after the initial allergic reaction. However, the observation time should be individualized based on the severity of the anaphylaxis. Longer periods of observation should be considered for patients who ingested the allergen, required more than one dose of epinephrine, had hypotension or pharyngeal edema, or have a history of asthma (Campbell et al., 2014).

Nursing Management

If a patient is experiencing an allergic response, the nurse assesses the patient for signs and symptoms of anaphylaxis. Airway, breathing pattern, and vital signs are assessed. The patient is observed for signs of increasing edema and respiratory distress. Prompt notification of the rapid response team, the provider, or both is required. Rapid initiation of emergency measures (e.g., intubation, administration of emergency medications, insertion of intravenous lines, fluid administration, and oxygen administration) is important to reduce the severity of the reaction and to restore cardiovascular function. The nurse

documents the interventions used and the patient's vital signs and response to treatment.

The patient who has recovered from anaphylaxis needs an explanation of what occurred, instruction about avoiding future exposure to antigens, and how to administer emergency medications to treat anaphylaxis. The patient must be instructed about antigens that should be avoided and about other strategies to prevent recurrence of anaphylaxis. All patients who have experienced an anaphylactic reaction should receive a prescription for auto-injectable epinephrine devices. The nurse instructs the patient and family in their use and has the patient and family demonstrate correct administration (see Chart 56-3).

Allergic Rhinitis

Allergic rhinitis (hay fever, seasonal allergic rhinitis) is the most common form of respiratory allergy, which is presumed to be mediated by an immediate (type I hypersensitivity) immunologic reaction. The incidence of allergic rhinitis in India is 20%–30% (Chandrika, 2017). It is a common cause of hospital visits. Symptoms are similar to those of viral rhinitis (see Chapter 40) but are usually more persistent and demonstrate seasonal variation; rhinitis is considered to be the allergic form if the symptoms are caused by an allergen-specific IgE-mediated immunologic response. However, approximately one third of patients with rhinitis have associated conjunctivitis, sinusitis, and asthma (Baran et al, 2014); (Lehrer, Mullol, Agredo, et al., 2014). The proportion of patients with the allergic form of rhinitis increases with age. It often occurs with other conditions, such as asthma, and cystic fibrosis (Rosenfeld et al., 2015). If symptoms are severe, allergic rhinitis may interfere with sleep, leisure, school, and overall quality of life (Sheikh, 2015). Chronic rhinitis accounts for an average of 1 to 2 missed work days per patient per year. These patients experience a 36% reduction in on-the-job effectiveness and 38% loss of productivity (Sheikh, 2015).

Early diagnosis and adequate treatment are essential to reduce complications and relieve symptoms.

Because allergic rhinitis is induced by airborne pollens or molds, it is characterized by the following seasonal occurrences (Sheikh, 2015): Common allergens causing allergic rhinitis in India are polyvalent house dust, pollen, house dust mites, fungi, dander, insect, and food (Chandrika, 2017).

Pathophysiology

Sensitization begins by ingestion or inhalation of an antigen. On re-exposure, the nasal mucosa reacts by the slowing of ciliary action, edema formation, and leukocyte (primarily eosinophil) infiltration. Histamine is the major mediator of allergic reactions in the nasal mucosa. Tissue edema results from vasodilation and increased capillary permeability.

Clinical Manifestations

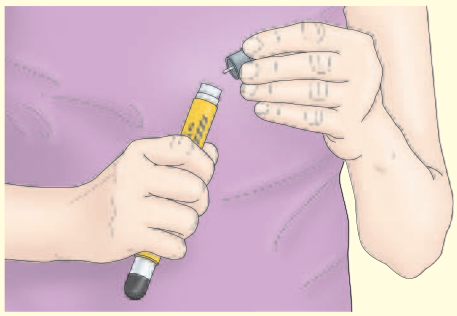
The four major signs and symptoms of allergic rhinitis include copious amounts of serous nasal discharge, nasal congestion,

Chart 56-3 PATIENT EDUCATION

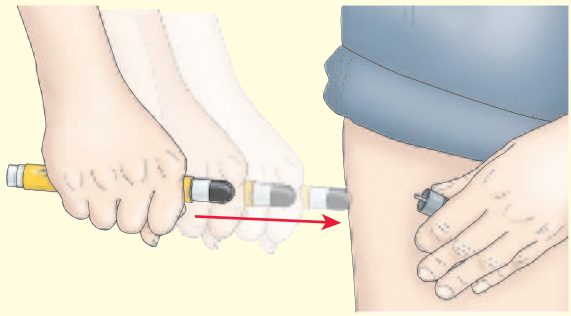
Self-Administration of Epinephrine

The nurse instructs the patient to:

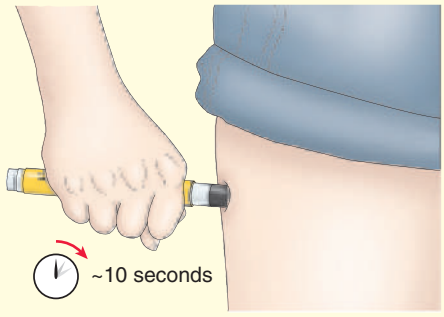
1. After removing the EpiPen autoinjector from its carrying tube, grasp the unit with the orange tip (injecting end) pointing downward. Form a fist around the unit with the orange tip down; with your other hand, remove the blue safety release cap.



2. Hold the black tip near outer thigh. Swing and **jab firmly** into the outer thigh until a click is heard with the device perpendicular (90-degree angle) to the thigh. Do NOT inject into buttocks.



3. Hold firmly against the thigh for approximately 10 seconds. Remove the unit from the thigh, and gently massage the injection area for 10 seconds. Call for medical help, if required. Carefully place the used autoinjector unit, needle-end first, into the device storage tube without bending the needle. Screw on the storage tube completely, and take it with you to the hospital emergency room.



sneezing, as well as nose and throat itching. Patients may experience post-nasal drip, itching, watery eyes, headache, and hyposomnia (Baran et al., 2014). Bronchial asthma is more persistent in patients with chronic rhinitis than in those with allergic rhinitis (Lehrer et al., 2014). The symptoms of this chronic condition depend on environmental exposure and intrinsic host responsiveness. Allergic rhinitis can affect quality of life by also producing sleep disturbance, impairment of daily activities, and missed school and work (Fleisher et al., 2013).

Assessment and Diagnostic Findings

Diagnosis of seasonal allergic rhinitis is based on history, physical examination, and diagnostic test results. Diagnostic tests include nasal smears, peripheral blood counts, total serum IgE, epicutaneous and intradermal testing, serum-specific IgE, and nasal provocation tests. Results indicative of allergy as the cause of rhinitis include increased IgE and eosinophil levels and positive reactions on allergen testing. False-positive and false-negative responses to these tests, particularly skin testing, may occur (Fleisher et al., 2013).

Medical Management

The goal of therapy is to provide relief from symptoms. Therapy may include one or all of the following interventions: avoidance therapy, pharmacologic therapy, and immunotherapy. Verbal instructions must be reinforced by written information. Knowledge of general concepts regarding assessment and therapy in allergic diseases is important so that the patient can learn to manage certain conditions as well as prevent severe reactions and illnesses.

Avoidance Therapy

In avoidance therapy, every attempt is made to remove the allergens that act as precipitating factors. Simple measures and environmental controls are often effective in decreasing symptoms. Examples include the use of air conditioners, air cleaners, humidifiers, and dehumidifiers; removal of dust-catching furnishings, carpets, and window coverings; removal of pets from the home or bedroom; the use of pillow and mattress covers that are impermeable to dust mites; and a smoke-free environment (Sheikh, 2015). Additional measures include changing clothing when coming in from outside, showering to wash allergens from hair and skin, and using an over-the-counter nasal irrigation device or saline nasal spray to reduce allergens in the nasal passages. Because multiple allergens are often implicated, multiple measures to avoid exposure to allergens are often necessary (Bleier, 2015); (Sheikh, 2015). High-efficiency particulate air (HEPA) purifiers and vacuum cleaner filters may also be used to reduce allergens in the environment. Research suggests that multiple avoidance strategies tailored to a person's risk factors can reduce the severity of symptoms, the number of work or school days missed because of symptoms, and the number of unscheduled health care visits for treatment (Sheikh, 2015). In many cases, it is impossible to avoid exposure to all environmental allergens, so pharmacologic therapy or immunotherapy is needed.

Pharmacologic Therapy

Antihistamines

Antihistamines, classified as H_1 receptor antagonists (or H_1 blockers), are used in the management of mild allergic disorders. H_1 blockers bind selectively to H_1 receptors, preventing the actions of histamines at these sites. They do not prevent the release of histamine from mast cells or basophils. The H_1 antagonists have no effect on H_2 receptors, but they do have the ability to bind to nonhistaminic receptors. The ability of certain antihistamines to bind to and block muscarinic receptors underlies several of the prominent anticholinergic side effects of these medications.

Oral antihistamines, which are readily absorbed, are most effective when given at the first occurrence of symptoms, because they prevent the development of new symptoms. The effectiveness of these medications is limited to certain patients with hay fever, vasomotor rhinitis, urticaria (hives), and mild asthma. They are rarely effective in other conditions or in any severe conditions (Frandsen & Pennington, 2014); (Hodgson & Kizior, 2014).

Antihistamines are frequently prescribed for the symptomatic relief of allergic rhinitis. The major side effects are drowsiness and dry mouth (Hwang & Patel, 2015); (Rosenfeld et al., 2015). Additional side effects include anxiety, agitation, urinary retention, blurred vision, anorexia, nausea, and vomiting (Frandsen & Pennington, 2014); (Hodgson & Kizior, 2014).

Antihistamines are contraindicated during pregnancy, in nursing mothers and newborns, in children and older adults, and in patients with hypersensitivity to the drugs whose conditions may be aggravated by muscarinic blockade (e.g., asthma, urinary retention, open-angle glaucoma, hypertension, prostatic hyperplasia) (Frandsen & Pennington, 2014); (Hodgson & Kizior, 2014); (Katzung & Trevor, 2015).

Second-generation or nonsedating H_1 receptor antagonists are newer types of antihistamines. Unlike first-generation H_1 receptor antagonists, they do not readily enter the brain from the blood (Fleisher, et al., 2013); (Frandsen & Pennington, 2014). They bind to peripheral rather than central nervous system H_1 receptors, causing less sedation. Examples of these medications are loratadine (Claritin), cetirizine (Zyrtec), and fexofenadine (Allegra). Selected H_1 antihistamines are shown in Table 56-2.

Antihistamines may also be combined with decongestants to reduce the nasal congestion associated with allergies. Most combination products are available as over-the-counter (nonprescription) medications; examples are loratadine/pseudoephedrine (Claritin-D) and cetirizine/pseudoephedrine (Zyrtec-D). Decongestants can cause an increase in blood pressure; therefore, patients with a history of hypertension should be cautioned about long-term use of any medication that contains decongestants (Bleier, 2015); (Hodgson & Kizior, 2014).

Adrenergic Agents

Adrenergic agents, which are vasoconstrictors of mucosal vessels, are used topically in nasal (Afrin) and ophthalmic (Alphagan P) formulations in addition to the oral route (pseudoephedrine [Sudafed]) (Frandsen & Pennington, 2014); (Hodgson & Kizior, 2014). The topical route (drops and sprays) causes fewer side effects than oral administration; however, the use of drops and sprays should be limited to a few days to avoid rebound congestion. Adrenergic nasal decongestants are applied topically to the nasal mucosa for the relief of nasal congestion. They activate the alpha-adrenergic receptor sites on the smooth muscle of the nasal mucosal blood vessels, reducing local blood flow, fluid exudation, and mucosal edema. Topical ophthalmic drops are used for symptomatic relief of eye irritations caused by allergies. Potential side effects include hypertension, dysrhythmias, palpitations, central nervous system stimulation, irritability, tremor, and tachyphylaxis (acceleration of hemodynamic status).

TABLE 56-2 Selected H_1 Antihistamines

H_1 Antihistamine	Contraindications	Major Side Effects	Nursing Implications and Patient Education
First-Generation H_1 Antihistamines (Sedating)			
Diphenhydramine (Benadryl)	Allergy to any antihistamines Third trimester of pregnancy Lactation Use cautiously with narrow-angle glaucoma, asthma, stenosing peptic ulcer, benign prostatic hyperplasia (BPH) or bladder neck obstruction, first and second trimester of pregnancy, older patients, hypertension.	Drowsiness, confusion, dizziness, dry mouth, nausea, vomiting, photosensitivity, urinary retention	Administer with food if gastrointestinal (GI) upset occurs. Caution patients to avoid alcohol, driving, or engaging in any hazardous activities until central nervous system (CNS) response to medication is stabilized. Suggest sucking on sugarless lozenges or ice chips for relief of dry mouth. Encourage the use of sunscreen and hat while outdoors. Assess for urinary retention; monitor urinary output.
Chlorpheniramine (Chlor-Trimeton)	Allergy to any antihistamines Third trimester of pregnancy Lactation Use cautiously with narrow-angle glaucoma, asthma, stenosing peptic ulcer, BPH or bladder neck obstruction, first and second trimester of pregnancy, older patients, hypertension.	Drowsiness, sedation, and dizziness, although less than other sedating agents; confusion, dry mouth, nausea, vomiting, urinary retention, epigastric distress, thickening of bronchial secretions	Caution patients to avoid alcohol, driving, or engaging in any hazardous activities until CNS response to medication is stabilized. Suggest sucking on sugarless lozenges or ice chips for relief of dry mouth. Recommend the use of a humidifier.
Hydroxyzine (Atarax)	Allergy to hydroxyzine or cetirizine (Zyrtec), pregnancy, lactation, hypertension	Drowsiness; dry mouth; involuntary motor activity, including tremor and seizures	Caution patients to avoid alcohol, driving, or engaging in any hazardous activities until CNS response to medication is stabilized. Suggest sucking on sugarless lozenges or ice chips for relief of dry mouth. Instruct patients to report tremors.
Second-Generation H_1 Antihistamines (Nonsedating)			
Cetirizine (Zyrtec)	Allergy to any antihistamines Narrow-angle glaucoma Asthma Stenosing peptic ulcer BPH or bladder neck obstruction Lactation Hypertension	Dry nasal mucosa, thickening of bronchial secretions	Can be taken without regard to meals. Instruct patients to use caution if driving or performing tasks that require alertness. Recommend the use of a humidifier.
Desloratadine (Clarinex)	Allergy to loratadine (Alavert, Claritin) Lactation Use cautiously with renal or hepatic impairment, pregnancy, hypertension.	Somnolence, nervousness, dizziness, fatigue, dry mouth	Can be taken without regard to meals. Suggest sucking on sugarless lozenges or ice chips for relief of dry mouth. Recommend the use of a humidifier.
Loratadine (Alavert, Claritin)	Allergy to any antihistamines Narrow-angle glaucoma Asthma Stenosing peptic ulcer BPH or bladder neck obstruction Hypertension	Headache, nervousness, dizziness, depression, edema, increased appetite	Instruct patients to take on empty stomach (1 hour before or 2 hours after meals or food). Instruct patients to avoid alcohol and to use caution if driving or performing tasks that require alertness. Suggest sucking on sugarless lozenges or ice chips for relief of dry mouth. Recommend the use of a humidifier.
Fexofenadine (Allegra)	Allergy to any antihistamines Pregnancy Lactation Use cautiously with hepatic or renal impairment, older patients, hypertension.	Fatigue, drowsiness, GI upset	Should not be given within 15 minutes of ingestion of antacids. Instruct patients to use caution if driving or performing tasks that require alertness.Recommend the use of a humidifier.
Levocetirizine (Xyzal)	Hypersensitivity to any antihistamines End-stage renal disease Hemodialysis Use cautiously with pregnancy, lactation, older patients.	Drowsiness, GI disturbance, headache	Can be taken without regard to meals. Instruct patients to use caution if driving or performing tasks that require alertness. Recommend the use of a humidifier.

Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Mast Cell Stabilizers

Intranasal cromolyn sodium (NasalCrom) is a spray that acts by stabilizing the mast cell membrane, thus reducing the release of histamine and other mediators of the allergic response. In addition, it inhibits macrophages, eosinophils, monocytes, and platelets involved in the immune response (Arcangelo & Peterson, 2013). Cromolyn interrupts the physiologic response to nasal antigens, and it is used prophylactically (before the exposure to allergens) to prevent the onset of symptoms and to treat symptoms once they occur. It is also used therapeutically in chronic allergic rhinitis. This spray is as effective as antihistamines but is less effective than intranasal corticosteroids in the treatment of seasonal allergic rhinitis. The patient must be informed that the beneficial effects of the medication may take a week or so to manifest. The medication is of no benefit in the treatment of nonallergic rhinitis. Adverse effects (e.g., sneezing, local stinging and burning sensations) are usually mild.

Corticosteroids

Intranasal corticosteroids are indicated in more severe cases of allergic and perennial rhinitis that cannot be controlled by more conventional medications, such as decongestants, antihistamines, and intranasal cromolyn. Examples of these medications include beclomethasone (Beconase, Qnasl), budesonide (Rhinocort), flunisolide (AeroSpan), and triamcinolone (Nasacort) (Comerford, 2015).

Because of their anti-inflammatory actions, corticosteroids are equally effective in preventing or suppressing the major symptoms of allergic rhinitis. These medications are given by metered-spray devices. If the nasal passages are blocked, a topical decongestant may be used to clear the passages before the administration of the intranasal corticosteroid. Patients must be aware that full benefit may not be achieved for several days to 2 weeks. Adverse effects of intranasal corticosteroids are mild and include drying of the nasal mucosa and burning and itching sensations caused by the vehicle used to administer the medication. Recommended use of this medication is limited to 30 days. Beclomethasone, budesonide, flunisolide, and triamcinolone are deactivated rapidly after absorption, so they do not achieve significant blood levels. Because corticosteroids suppress host defenses, they must be used with caution in patients with tuberculosis or untreated bacterial infections of the lungs. Patients taking corticosteroids are at risk for infection and suppression of typical manifestations of inflammation, because host defenses are compromised. Inhaled corticosteroids do not affect the immune system to the same degree as systemic corticosteroids (i.e., oral corticosteroids). Because corticosteroids are inhaled into the upper respiratory tract, tuberculosis or untreated bacterial infections of the lungs may become apparent and progress. Whenever possible, patients with tuberculosis or other bacterial infections of the lungs should avoid inhaled corticosteroids.

Oral and parenteral corticosteroids are used when conventional therapy has failed and symptoms are severe and of short duration (Frandsen & Pennington, 2014); (Hodgson & Kizior, 2014). They can control symptoms of allergic reactions such as hay fever, medication-induced allergies, and allergic reactions to insect stings. Because the response to corticosteroids is delayed, these agents have little or no value in acute therapy for severe reactions such as anaphylaxis.

Nursing Alert: Patients who receive high-dose or long-term corticosteroid therapy must be cautioned not to stop taking the medication suddenly. Doses are tapered when discontinuing this medication to avoid adrenal insufficiency.

The patient is also instructed about side effects, which include fluid retention, weight gain, hypertension, gastric irritation, glucose intolerance, and adrenal suppression. Further discussion of corticosteroids is provided in Chapter 32, Table 32-4.

Leukotriene Modifiers

Leukotrienes have many effects on the inflammatory cycle. Leukotriene modifiers, such as zafirlukast (Accolate) and montelukast (Singulair), block the synthesis or action of leukotrienes and prevent the signs and symptoms associated with asthma (see Table 56-3).

Leukotriene modifiers are for long-term use, and patients should be advised to take their medication daily. Patients take appropriate "rescue" medications for symptom exacerbation but continue to take the leukotriene modifier on a daily basis. The National Asthma Education and Prevention Program (NAEPP) suggests using a leukotriene modifier in conjunction with an inhaled corticosteroid for mild persistent asthma (National Institute of Allergy and Infectious Disease [NIAID], 2013).

Immunotherapy

Allergen desensitization (allergen immunotherapy, hyposensitization) is primarily used to treat IgE-mediated diseases by injections of allergen extracts. Immunotherapy, also referred to as allergy vaccine therapy, involves the administration of gradually increasing quantities of specific allergens to the patient until a dose is reached that is effective in reducing disease severity from natural exposure. This is an effective treatment for 80% to 90% of certain allergens such as grass and pollen (ASCIA, 2015); (Senti, von Moos, Graf, et al., 2015); (Sheikh, 2015). This type of therapy provides an adjunct to symptomatic pharmacologic therapy and can be used when avoidance of allergens is not possible. Specific immunotherapy has been used in the treatment

TABLE 56-3 Leukotriene Modifiers

Leukotriene Modifier	Available Formulations	Frequency of Dosing
Leukotriene-Receptor Antagonists		
Zafirlukast (Accolate)	Tablets: 10 mg; 20 mg	Taken twice a day
Montelukast (Singulair)	Tablets: 10 mg	Taken once a day in pm
	Chewable tablets: 4 mg; 5 mg	
	Granules: 4 mg/packet	
Leukotriene-Receptor Inhibitors		
Zileuton (Zyflo CR)	Tablets: 600 mg extended release	Taken twice a day within 1 hour after morning and evening meals

Chart 56-4

Immunotherapy: Indications and Contraindications

Indications

- Allergic rhinitis, conjunctivitis, or allergic asthma
- History of a systemic reaction to Hymenoptera and specific immunoglobulin E antibodies to Hymenoptera venom
- Desire to avoid the long-term use, potential adverse effects, or costs of medications
- Lack of control of symptoms by avoidance measures or the use of medications

Contraindications

- The use of beta-blocker or angiotensin-converting enzyme inhibitor therapy, which may mask early signs of anaphylaxis
- Presence of significant pulmonary or cardiac disease or organ failure
- Inability of the patient to recognize or report signs and symptoms of a systemic reaction
- Nonadherence of the patient to other therapeutic regimens and nonlikelihood that the patient will adhere to the immunization schedule (often weekly for an indefinite period)
- Inability to monitor the patient for at least 30 minutes after administration of immunotherapy
- Absence of equipment or adequate personnel to respond to allergic reaction if one occurs

of allergic disorders for many years. Goals of immunotherapy include reducing the level of circulating IgE, increasing the level of blocking antibody IgG, and reducing mediator cell sensitivity. Immunotherapy has been most effective for ragweed pollen; however, treatment for grass, tree pollen, cat dander, and house dust mite allergens has also been effective. Indications and contraindications for immunotherapy are presented in Chart 56-4.

Correlation of a positive skin test with a positive allergy history is an indication for immunotherapy if the allergen cannot be avoided. The benefit of immunotherapy has been fairly well established in instances of allergic rhinitis and bronchial asthma that are clearly due to sensitivity to one of the common pollens, molds, or household dust. Unlike antiallergy medication, allergen immunotherapy has the potential to alter the allergic disease course after 3 to 5 years of therapy. Because it may prevent the progression or development of asthma or multiple or additional allergies, it is also considered to be a potential preventive measure (Sheikh, 2015). The patient must understand what to expect and the importance of continuing therapy for several years before immunotherapy is accomplished. When skin tests are performed, the results are correlated with symptoms; treatment is based on the patient's needs rather than on the results of skin tests.

There are three methods of immunotherapy: subcutaneous immunotherapy (SIT), sublingual immunotherapy (SLIT), and epicutaneous immunotherapy (EPIT).

Subcutaneous Immunotherapy

The most common method of treatment is SIT, which consists of the serial injection of one or more antigens that are selected in each particular case on the basis of skin testing. This method provides a simple and efficient technique for targeting IgE antibodies to specific antigens. Specific treatment consists of injecting extracts of the allergens that cause symptoms in a particular patient. Injections begin with very small amounts and are gradually increased, usually at weekly intervals, until a maximum tolerated dose is attained. Although severe systemic reactions are rare, the risk of systemic and potentially fatal anaphylaxis exists. It tends to occur most frequently at the induction or "up-dosing" phase. Therefore, the patient must be monitored after administration of immunotherapy. Because of the risk of anaphylaxis, injections should not be given by a lay person or by the patient. The patient must remain in the office or clinic for at least 30 minutes after the injection and is observed for possible systemic symptoms. If a large, local swelling develops at the injection site, the next dose should not be increased, because this may be a warning sign of a possible systemic reaction (ASCIA, 2015); (Sheikh, 2015).

Maintenance booster injections are given at 2- to 4-week intervals, frequently for a period of several years, before the maximum benefit is achieved, although some patients will note early improvement in their symptoms. Long-term benefit seems to be related to the cumulative dose of vaccine given over time (ASCIA, 2015); (Sheikh, 2015).

Nursing Alert: Because the injection of an allergen may induce systemic reactions, such injections are given only in a setting where epinephrine is immediately available (i.e., primary provider's clinic).

Sublingual Immunotherapy

In April 2014, the U.S. Food and Drug Administration (FDA) approved the use of a SLIT. SLIT has been reported to have a 30% to 40% reduction in reactions and rescue medication usage in seasonal allergic rhinitis. Administration of SLIT includes a buildup phase that is followed by a treatment plan of three times per week with a rapid dissolving tablet or liquid containing allergen extracts. Recent studies show comparable efficacy of SLIT with SIT (Senti et al., 2015). Systemic side effects are rare but have been reported in patients who also report systemic reactions with SIT. Side effects include irritation, minor swelling or itching inside the mouth, and stomach upset and nausea.

Epicutaneous Immunotherapy

EPIT represents an alternative allergen immunotherapy with delivery of the allergen to the epidermis. Because the epidermis is less vascular, there is reduced risk of systemic allergic side effects due to inadvertent intravascular allergen delivery. Reports from the completed trials of EPIT may find potential application in the management of IgE-mediated allergies, but more research is needed to define an optimal regimen that balances clinical efficacy and safety (Senti et al., 2015).

Immunotherapy should not be initiated during pregnancy; for patients who have been receiving immunotherapy before pregnancy, the dosage should not be increased during pregnancy.

Therapeutic failure is evident when a patient does not experience a decrease of symptoms within 12 to 24 months, fails to develop increased tolerance to known allergens, and cannot decrease the use of medications to reduce symptoms. Potential causes of treatment failure include misdiagnosis of allergies, inadequate doses of allergen, newly developed allergies, and inadequate environmental controls.

NURSING PROCESS

The Patient with Allergic Rhinitis

Assessment

The examination and history of the patient reveal sneezing, often in paroxysms; thin and watery nasal discharge; itching

eyes and nose; lacrimation; and occasionally headache. The health history includes a personal or family history of allergy. The allergy assessment identifies the nature of antigens, seasonal changes in symptoms, and medication history. The nurse also obtains subjective data about how the patient feels just before symptoms become obvious, such as the occurrence of pruritus, breathing problems, and tingling sensations. In addition to these symptoms, hoarseness, wheezing, hives, rash, erythema, and edema are noted. Any relationship between emotional problems or stress and the triggering of allergy symptoms is assessed.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include:

- Ineffective breathing pattern related to allergic reaction
- Deficient knowledge about allergy and the recommended modifications in lifestyle and self-care practices
- Ineffective coping with chronicity of condition and need for environmental modifications

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Anaphylaxis
- Impaired breathing
- Nonadherence to the therapeutic regimen

Planning and Goals

The goals for the patient may include restoration of a breathing pattern that provides adequate ventilation, increased knowledge about the causes and control of allergic symptoms, improved coping with alterations and modifications, and absence of complications.

Nursing Interventions

Improving Breathing Pattern

The patient is instructed and assisted to modify the environment to reduce the severity of allergic symptoms or to prevent their occurrence. The patient is also instructed to reduce exposure to people with upper respiratory tract infections. Adherence to medication schedules and other treatment regimens is encouraged and reinforced.

Promoting Understanding of Allergy and Allergy Control

Instruction includes strategies to minimize exposure to allergens and explanation about desensitization procedures and correct use of medications. The nurse informs and reminds the patient of the importance of keeping appointments for desensitization procedures, because dosages are usually adjusted on a weekly basis, and missed appointments may interfere with the dosage adjustment.

Patients need to understand the difference between rescue medications for allergy exacerbation and seasonal flares (e.g., antihistamines) and medications used for allergy control throughout the year (e.g., inhaled corticosteroids, leukotriene modifiers). Patients also need to understand that medications for allergy exacerbation and seasonal flares should be used only when the allergy is apparent. Continued use of these medications when not required can result in tolerance; consequently, the medications will be ineffective when needed.

Coping With a Chronic Disorder

Although allergic reactions are infrequently life-threatening, they require vigilance to avoid allergens and modification of the lifestyle or environment to prevent recurrence of symptoms. Allergic symptoms are often present year-round and create discomfort and inconvenience for the patient. Although patients may not feel ill during allergy seasons, they often do not feel well, either. The need to be alert for possible allergens in the environment may be tiresome, placing a burden on the patient's ability to lead a normal life. Stress related to these difficulties may in turn increase the frequency or severity of symptoms. To assist the patient in adjusting to these modifications, the nurse must have an appreciation of the difficulties encountered by the patient. The patient is encouraged to verbalize feelings and concerns in a supportive environment and to identify strategies to deal with them effectively.

Monitoring and Managing Potential Complications

Anaphylaxis and Impaired Breathing. Respiratory and cardiovascular functioning can be significantly altered during allergic reactions by the reaction itself or by the medications used to treat reactions. The respiratory status is evaluated by monitoring the respiratory rate and pattern and by assessing for breathing difficulties or abnormal lung sounds. The pulse rate and rhythm and blood pressure are monitored to assess cardiovascular status regularly or any time the patient reports symptoms such as itching or difficulty breathing. In the event of signs and symptoms suggestive of anaphylaxis, emergency medications and equipment must be available for immediate use. See Chapter 8 for treatment of anaphylactic shock.

Nonadherence to the Therapeutic Regimen. Knowledge about the treatment regimen does not ensure adherence. Having the patient identify potential barriers and explore acceptable solutions for effective management of the condition (e.g., installing tile floors rather than carpet, not exposing to known allergens, refraining from going into the dusty areas, avoiding foods that cause allergy) can increase adherence to the treatment regimen.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. The patient is instructed about strategies to minimize exposure to allergens, the actions and adverse effects of medications, and the correct use of medications. The patient should know the name, dose, frequency, actions, and side effects of all medications taken.

Instruction about strategies to control allergic symptoms is based on the needs of the patient as determined by the results of tests, the severity of symptoms, and the motivation of the patient and family to deal with the condition. Suggestions for patients who are sensitive to dust and mold in the home are given in Chart 56-5.

If the patient is to undergo SIT immunotherapy, the nurse reinforces the primary provider's explanation regarding the purpose and procedure. Instructions are given regarding the series of injections, which usually are given initially every week and then at 2- to 4-week intervals. These instructions include remaining in the primary provider's office or the clinic for at least 30 minutes after the injection, so that emergency treatment can be given if the patient has a reaction; avoiding rubbing or scratching the injection site; and continuing with the series for the period of time required. In addition, the patient and family are instructed about emergency treatment of severe allergic symptoms.

Because antihistamines may produce drowsiness, the patient is cautioned about this and other side effects applicable to the medication. Operating machinery, driving a car, and performing activities that require intense concentration should be postponed. The patient is also informed about the dangers of drinking alcohol when taking antihistamines, because they tend to exaggerate the effects of alcohol.

Chart 56-5 HOME CARE CHECKLIST

Allergy Management

At the completion of education, the patient, caregiver, or both will be able to:

- State the impact of environmental allergens (e.g., dust, molds, perfumes, foods) on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State changes in home environment necessary to minimize exposure to allergens.
  - Removing drapes, curtains, and venetian blinds and replacing them with pull shades; covering the mattress with a hypoallergenic cover that can be zipped; and removing rugs and replacing them with wood flooring or linoleum.
  - Reducing dust in the house as a whole by using steam or hot water for heating and using high-efficiency particulate air (HEPA) purifiers or air-conditioning.
  - Washing the floor and dusting and vacuuming daily, using clean filters, wearing a mask whenever cleaning is being done.
  - Replacing stuffed furniture with wood pieces that can easily be dusted.
  - Avoiding the use of tufted bedspreads, stuffed toys, and feather pillows and replacing them with washable cotton material.
  - Avoiding the use of any clothing that causes itching.
- Verbalize ways to reduce exposure to pollens or molds by identifying seasons of the year when pollen counts are high; wearing a mask at times of increased exposure (windy days and when grass is being cut); and avoiding contact with weeds, dry leaves, and freshly cut grass.
- State rationale for seeking air-conditioned areas at the height of the allergy season.
- State rationale for avoiding sprays and perfumes.
- State rationale for the use of hypoallergenic cosmetics.
- State rationale for taking prescribed medications as ordered.
- Identify specific foods that may cause allergic symptoms and develop a list of foods to avoid (e.g., fish, nuts, eggs, chocolate).
- Verbalize ways to cope with stress successfully, plans for regular exercise, and rationale for obtaining adequate rest.
- State how to reach primary provider with questions or complications.
- State time and date of follow-up appointments, testing.
- Identify the need for health promotion, disease prevention, and screening activities.

ADLs, activities of daily living; IADLs, independent activities of daily living.

The patient must be aware of the effects caused by overuse of the sympathomimetic agents in nose drops or sprays, because a condition referred to as rhinitis medicamentosa may result. After topical application of the medication, a rebound period occurs in which the nasal mucous membranes become more edematous and congested than they were before the medication was used. Such a reaction encourages the use of more medication, and a cyclic pattern results. The topical agent must be discontinued immediately and completely to correct this problem.

Nursing Alert: In rhinitis medicamentosa, the rebound reaction from the overuse of sympathomimetic nose drops or sprays worsens the congestion, causing the patient to use more of the medication and thus leads to more nasal congestion. This condition should not be confused with a patient developing tolerance to the drug.

Continuing and Transitional Care. Follow-up telephone calls to the patient are often reassuring to the patient and family and provide an opportunity for the nurse to answer any questions. The patient is reminded to keep follow-up appointments and informed about the importance of continuing with treatment. The importance of participating in health promotion activities and health screening is also emphasized.

Evaluation

Expected patient outcomes may include:

1. Exhibits a breathing pattern that provides adequate ventilation
   a. Demonstrates lungs clear on auscultation
   b. Exhibits absence of adventitious breath sounds (crackles, rhonchi, wheezing)
   c. Has a normal respiratory rate and pattern
   d. Reports no complaints of respiratory distress (shortness of breath, difficulty on inspiration or expiration)
2. Demonstrates knowledge about allergy and strategies to control symptoms
   a. Identifies causative allergens, if known
   b. States methods of avoiding allergens and controlling indoor and outdoor precipitating factors
   c. Removes from the environment items that retain dust
   d. Wears a dampened mask if dust or mold may be a problem
   e. Avoids smoke-filled rooms and dust-filled or freshly sprayed areas
   f. Uses air-conditioning for a major part of the day when allergens are high
   g. Takes antihistamines as prescribed; participates in hyposensitization program, if applicable
   h. Describes name, purpose, side effects, and method of administration of prescribed medications
   i. Identifies when to seek immediate medical attention for severe allergic responses
   j. Describes activities that are possible, including ways to participate in activities without activating the allergies
3. Adapts to the inconveniences of an allergy
   a. Relates the emotional aspects of the allergic response
   b. Demonstrates the use of measures to cope positively with allergy
4. Demonstrates absence of complications
   a. Exhibits vital signs within normal limits
   b. Reports no symptoms or episodes of anaphylaxis (urticaria, itching, peripheral tingling, fullness in the mouth and throat, flushing, difficulty swallowing, coughing, wheezing, or difficulty breathing)
   c. Demonstrates correct procedure to self-administer emergency medications to treat severe allergic reaction
   d. Correctly states medication names, dose and frequency of administration, and medication actions
   e. Correctly identifies side effects and untoward signs and symptoms to report to primary provider
   f. Discusses acceptable lifestyle changes and solutions for identified potential barriers to adherence to treatment and medication regimen

Contact Dermatitis

Contact dermatitis, a type IV delayed hypersensitivity reaction, is an acute or chronic skin condition caused by contact with an exogenous substance that elicits an allergic response. There are four basic types: allergic, irritant, phototoxic, and photo allergic (see Table 56-4). Eighty percent of cases are caused by excessive exposure to or additive effects of irritants (e.g., soaps, detergents, organic solvents). Skin sensitivity may develop after brief or prolonged periods of exposure, and the clinical picture may appear hours or weeks after the sensitized skin has been exposed.

Clinical Manifestations

Symptoms include itching, burning, erythema, skin lesions (vesicles and papules), and edema, followed by skin thickening, hardening, and scaling (Fonacier, Bernstein, Pancheco, et al., 2015). In severe responses, hemorrhagic bullae may develop. Repeated reactions may be accompanied by thickening of the skin and pigmentary changes. Secondary invasion by bacteria may develop in skin that is abraded by rubbing or scratching. Usually, there are no systemic symptoms unless the eruption is widespread (Habif, 2016).

Assessment and Diagnostic Findings

Determining allergens responsible requires a history, physical examination, and patch testing.

Assessment should include the date of onset, and any identifiable relationship to work environment and skin care products (Habif, 2016). The location of the lesions, distribution of the dermatitis, absence of other etiologies, and the history of exposure aid in determining the condition (Fonacier et al., 2015). Patch testing and environmental history of exposure to contact allergens are required to verify the diagnosis. Patch testing is indicated in cases in which inflammation persists despite avoidance therapy. The patch test most commonly used is the Thin-layer Rapid Use Epicutaneous (T.R.U.E.) test (Habif, 2016).

Atopic Dermatitis

Atopic dermatitis is a type I immediate hypersensitivity disorder characterized by inflammation and hyper reactivity of the skin. The term is used synonymously with atopic eczema (AAAAI, 2015). Other terms used to describe this kind of disorder include atopic eczema, atopic dermatitis, and atopic dermatitis/eczema syndrome (AEDS). In a revised classification system developed to clarify terminology, AEDS includes both allergic and nonallergic disorders (Habif, 2016). Currently, *atopic dermatitis* is the most commonly used term and will be used for the purpose of this discussion.

Atopic dermatitis is a chronic pruritis inflammatory skin disease. Increased serum IgE levels have been indicated in 80% of the patients with a family history of type 1 allergies, allergic rhinitis, and asthma. This disorder affects 15% to 30% of children and 2% to 10% of adults in developed countries (AAAAI, 2015). Most patients have significant elevations of serum IgE and peripheral eosinophilia. The eosinophil count may be increased depending on concomitant respiratory allergies (Habif, 2016).

Pruritus and hyperirritability of the skin are the most consistent features of atopic dermatitis and are related to large amounts of histamine in the skin. Excessive dryness of the skin with resultant itching is related to changes in lipid content, sebaceous gland activity, and sweating. In response to stroking of the skin, immediate redness appears on the skin. Pallor follows in 15 to 30 seconds and persists for 1 to 3 minutes. Patterns of inflammation result from scratching of erythematous papules. Lesions develop secondary to the trauma of scratching and appear in areas of increased sweating and hypervascularity.

TABLE 56-4 Types, Testing, and Treatment of Contact Dermatitis

Type	Etiology	Clinical Presentation	Diagnostic Testing	Treatment
Allergic	Results from contact of skin and allergenic substance; has a sensitization period of 10–14 days	Vasodilation and perivascular infiltrates on the dermis Intracellular edema Usually seen on dorsal aspects of hand	Patch testing (contraindicated in acute, widespread dermatitis)	Avoidance of offending material Aluminum acetate (Burow Solution, Domeboro Powder) or cool water compress Systemic corticosteroids (prednisone) for 7–10 days Topical corticosteroids for mild cases Oral antihistamines to relieve pruritus
Irritant	Results from contact with a substance that chemically or physically damages the skin on a nonimmunologic basis; occurs after first exposure to irritant or repeated exposures to milder irritants over an extended time	Dryness lasting days to months Vesiculation, fissures, cracks Hands and lower arms most common areas	Clinical picture Appropriate negative patch tests	Identification and removal of source of irritation Application of hydrophilic cream or petrolatum to soothe and protect Topical corticosteroids and compresses for weeping lesions Antibiotics for infection and oral antihistamines for pruritus
Phototoxic	Resembles the irritant type but requires sun and a chemical in combination to damage the epidermis	Similar to irritant dermatitis	Photo-patch test	Same as for allergic and irritant dermatitis
Photo allergic	Resembles allergic dermatitis but requires light exposure in addition to allergen contact to produce immunologic reactivity	Similar to allergic dermatitis	Photo-patch test	Same as for allergic and irritant dermatitis

Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Atopic dermatitis is chronic, with remissions and exacerbations. This condition has a tendency to recur, with remission from adolescence to 20 years of age (Habif, 2016).

Nurses should be aware that atopic dermatitis is often linked in a process called the atopic march that often leads to asthma, allergic rhinitis, or food allergy (Fonacier et al., 2015). It is the result of interactions between susceptibility genes, the environment, defective function of the skin barrier, and immunologic responses.

Medical Management

Treatment of patients with atopic dermatitis must be individualized. Guidelines for treatment include identification and avoidance of contact with the offending agents; elimination of inflammatory disorders and infections; prescription of topical corticosteroids and non-steroidal anti-inflammatory agents; preservation and restoration of the stratum corneum layer; and prescription of antipruritic agents, oral antibiotics, and oral immunosuppressants for severely affected patients (Fonacier et al., 2015); (Habif, 2016).

Itching can be decreased by wearing cotton fabrics; washing with a mild detergent; humidifying dry heat in winter; maintaining room temperature at 20°C to 22.2°C (68°F to 72°F); using antihistamines such as diphenhydramine; and avoiding animals, dust, sprays, and perfumes. Keeping the skin moisturized with daily baths to hydrate the skin and the use of topical skin moisturizers is encouraged. Topical corticosteroids are used to prevent inflammation, and any infection is treated with antibiotics to eliminate *Staphylococcus aureus* when indicated (Fonacier et al., 2015); (Habif, 2016).

The use of immunosuppressive agents, such as cyclosporine (Neoral, Sandimmune), tacrolimus (Prograf, Protopic), and pimecrolimus (Elidel), may be effective in inhibiting T cells and mast cells involved in atopic dermatitis (Fonacier et al., 2015); (Habif, 2016).

Research is needed to assess the effectiveness and the adverse side effects of medications used to treat atopic dermatitis.

Nursing Management

Patients who experience atopic dermatitis and their families require assistance and support from the nurse to cope with the disorder. The symptoms are often disturbing to the patient and disruptive to the family. The appearance of the skin may affect the patient's self-esteem and their willingness to interact with others. Instructions and counseling about strategies to incorporate preventive measures and treatments into the lifestyle of the family may be helpful.

The patient and family need to be aware of signs of secondary infection and of the need to seek treatment if infection occurs. The nurse also educates the patient and family about the side effects of medications used in treatment.

Dermatitis Medicamentosa (Drug Reactions)

Dermatitis medicamentosa, a type I hypersensitivity disorder, is the term applied to skin rashes associated with certain medications. Although people react differently to each medication, certain medications tend to induce eruptions of similar types. This disorder is the leading cause of fatal anaphylaxis, comprising 43% of deaths from anaphylaxis. All routes of administration are potentially fatal, but drugs given parenterally incur the greatest risk. Cutaneous rashes are among the most common adverse reactions to medications and occur in approximately 2% to 3% of hospitalized patients (Fleisher et al., 2013); (Habif, 2016).

In general, drug reactions appear suddenly with characteristics that are more intense than the somewhat similar eruptions of infectious origin, and, with the exception of bromide and the iodide rashes, disappear rapidly after the medication is withdrawn (Comerford, 2015). Rashes may be accompanied by systemic or generalized symptoms. On discovery of a medication allergy, patients are warned that they have a hypersensitivity to a particular medication and are advised not to take it again. Penicillin, cephalosporin, and sulfonamide antibiotics are most commonly implicated (Habif, 2016). Patients should carry information identifying the hypersensitivity with them at all times.

Skin eruptions related to medication therapy suggest more serious hypersensitivities. Frequent assessment and prompt reporting of the appearance of any eruptions are important so that early treatment can be initiated. Some cutaneous drug reactions may indicate involvement of other organs and are known as complex drug reactions. Patients who suspect that a new rash may be caused by a drug allergy (newly prescribed medications, especially antibiotics such as penicillin or sulfa medications) should stop taking the medication immediately and contact their prescribing clinician, who will determine whether the medication and the rash are related.

Urticaria and Angioneurotic Edema

Urticaria (hives) is a type I hypersensitive allergic reaction of the skin that is characterized by the sudden appearance of edematous, pink or red wheals of variable size from 2 to 4 mm, and general pruritus. They may involve any part of the body, including the mucous membranes (especially those of the mouth), the larynx (occasionally with serious respiratory complications), and the gastrointestinal tract. This is a common condition with approximately 10% to 20% of people having one episode during their lifetime. Urticaria is most commonly instigated by infections, allergic reaction to food, insect stings, and medications (American Osteopathic College of Dermatology, 2015).

Each hive remains for a few minutes to several hours before disappearing. They usually fade within 24 to 48 hours, but new lesions may be developing simultaneously at other skin sites (Bernstein, Lang, Khan, et al., 2014). The condition usually resolves in 3 weeks. However, if this sequence continues for longer than 6 weeks, the condition is called *chronic urticaria.*

Management of the condition includes eliminating the causative drug or food; avoiding the use of nonsteroidal anti-inflammatory drugs (NSAIDs); minimizing potential aggravators, including heat, stress, alcohol, and tight clothes; administering antihistamines, and possibly a short course of corticosteroids (Prednisone) (AAAAI, 2015); (American Osteopathic College of Dermatology, 2015); (Fleisher et al., 2013); (Habif, 2016).

Angioneurotic edema (i.e., angioedema) involves the deeper layers of the skin, resulting in more diffuse swelling rather than the discrete lesions characteristic of hives. It is manifested by non-pruritic, brawny, non-pitting edema with well-defined margins and erythema similar to urticaria (Bernstein et al., 2014). Urticaria and angioedema often occur together (Habif, 2016).

The regions most often involved in angioedema are the lips, eyelids, cheeks, hands, feet, genitalia, and tongue; the mucous

membranes of the larynx, bronchi, and gastrointestinal canal may also be affected, particularly in the hereditary type (see discussion in the following section). On occasion, this reaction covers the entire back. Swellings may appear suddenly, in a few seconds or minutes, or slowly in 1 or 2 hours. In the latter case, their appearance is often preceded by itching or burning sensations. Seldom does more than a single swelling appear at one time, although one may develop while another is disappearing. Infrequently, swelling recurs in the same region. Individual lesions usually resolve in 24 hours (Fleisher et al., 2013); (AAAAI, 2015). On rare occasions, swelling may recur with remarkable regularity at intervals of 3 to 4 weeks.

Several frequently prescribed medications, such as angiotensin-converting enzyme inhibitors (captopril [Capoten]) and penicillin, may cause angioedema. The nurse needs to be aware of all medications the patient is taking and be alert to the potential of angioedema as a side effect.

Hereditary Angioedema

Hereditary angioedema is a rare, potentially life-threatening, autosomal dominant disorder (Cicardi & Zuraw, 2015). Although not an immunologic disorder in the usual sense, this condition is included because of its resemblance to allergic angioedema and because of the potential seriousness of the condition. Symptoms are caused by edema of the skin, the respiratory tract, or the digestive tract. Attacks may be precipitated by trauma, or they may seem to occur spontaneously.

Clinical Manifestations

When skin is involved, the swelling usually is diffuse, does not itch, and usually is not accompanied by urticaria. Gastrointestinal edema may cause abdominal pain severe enough to be incapacitating. Typically, attacks last 2 to 4 days and resolve without intervention; however, attacks can occasionally affect the subcutaneous and submucosal tissues in the region of the upper airway and can be associated with respiratory obstruction and asphyxiation (Cicardi & Zuraw, 2015).

Medical Management

Attacks usually subside within 2 to 4 days, but during this time the patient should be observed carefully for signs of laryngeal obstruction, which may necessitate tracheostomy as a lifesaving measure. Epinephrine, antihistamines, and corticosteroids are usually used in treatment, although their success is limited. (Cicardi & Zuraw, 2015); (Fleisher et al., 2013); (Habif, 2016).

Cold Urticaria

Familial atypical cold urticaria (FACU) and acquired cold urticaria (ACU) are additional diseases within the spectrum of urticaria induced by temperature exposure. FACU is an autosomal dominant condition, inherited from one affected parent, and symptoms usually begin at birth within the first 6 months of life (Fleisher et al., 2013). ACU most frequently affects children and young adults (Fleisher et al., 2013); (Habif, 2016).

Clinical Manifestations

Patients with FACU break out in hives (i.e., urticaria) when exposed to cold. The urticaria may be prompted by exposure to cold weather or cold water or after coming in contact with cold objects. Lesions occur within a few hours and usually subside in 2 days (Fleisher et al., 2013). Symptoms include fever, chills, conjunctiva infection, sweating, headache, and arthralgia. During the attack, the patient may develop leukocytosis, an increase in the erythrocyte sedimentation rate (ESR) and raised C-reactive protein levels (Ciccarelli, De Martinis, & Ginaldi, 2014).

Cold urticaria is diagnosed by physical testing. Ice cube provocation testing involves applying an ice cube to the skin of the forearm for 1 to 5 minutes. A positive test results in development of urticaria at the site in a patient with ACU. Clinical manifestations of FACU can be precipitated by the patient merely entering a 4°C (39°F) room.

Medical Management

Prevention involves avoidance of cold stimuli. Treatment involves bed rest, warmth, and corticosteroids to treat an acute attack (Ciccarelli et al., 2014).

All patients with any form of cold urticaria should carry an auto-injectable epinephrine device for emergency use because hives can progress to anaphylaxis.

Food Allergy

IgE-mediated food allergy, a type I hypersensitivity reaction, occurs in about 2% of the adult population; it is thought to occur in people who have a genetic predisposition combined with exposure to allergens early in life through the gastrointestinal or respiratory tract or nasal mucosa. More than 170 foods have been reported to cause IgE-mediated reactions (Sampson, Aceves, Brock, et al., 2014).

Almost any food can cause allergic symptoms. Any food can contain an allergen that results in anaphylaxis. The most common offenders are seafood (lobster, shrimp, crab, clams, fish), peanuts, tree nuts, berries, eggs, wheat, milk, and chocolate (Sampson et al., 2014). Peanut and tree nut (e.g., cashew, walnut) allergies are responsible for the most severe food allergy reactions. There is insufficient evidence that maternal diet during pregnancy or lactation affects the development of food allergies later in life (AAAAI, 2015); (NIAID, 2013); (Sampson et al., 2014).

One of the dangers of food allergens is that they may be hidden in other foods and not apparent to people who are susceptible to the allergen. For example, peanuts and peanut butter are often used in salad dressings and Asian, African, and Mexican cooking and may result in severe allergic reactions, including anaphylaxis. Previous contamination of equipment with allergens (e.g., peanuts) during preparation of another food product (e.g., chocolate cake) is enough to produce anaphylaxis in people with severe allergy (Fleischer, Sicherer, Greenhawt, et al., 2015).

Clinical Manifestations

Food allergy is the most common trigger for anaphylaxis. Symptoms occur in a few minutes to hours from exposure. The clinical symptoms are classic allergic symptoms (urticaria, dermatitis, wheezing, cough, laryngeal edema, angioedema) and gastrointestinal symptoms (itching; swelling of lips, tongue, and palate; abdominal pain; nausea; cramps; vomiting; and diarrhea) (NIAID, 2013); (Sampson et al., 2015).

Assessment and Diagnostic Findings

A careful diagnostic workup is required in any patient with suspected food hypersensitivity. Included are a detailed allergy

history, a physical examination, and pertinent diagnostic tests. Skin prick testing is used to identify the source of symptoms and assists in identifying specific foods as causative agents.

Medical Management

Therapy for food hypersensitivity includes elimination of the food responsible for the hypersensitivity (see Chart 56-6). Pharmacologic therapy is necessary for patients who cannot avoid exposure to offending foods and for patients with multiple food sensitivities not responsive to avoidance measures. Medication therapy involves the use of H_1 blockers, antihistamines, adrenergic agents, corticosteroids, and cromolyn sodium. All patients with food allergies, especially seafood and nuts, should have an auto-injectable epinephrine (e.g., EpiPen or Auvi-Q) device prescribed. Another essential aspect of management is educating patients and family members about how to recognize and manage the early stages of an acute anaphylactic reaction (AAAAI, 2015); (Campbell et al., 2014). Many food allergies disappear with time, particularly in children.

Nursing Management

In addition to participating in management of the allergic reaction, the nurse focuses on preventing future exposure of the patient to the food allergen. If a severe allergic or anaphylactic reaction to food allergens has occurred, the nurse must instruct the patient and family about strategies to prevent its recurrence (see Chart 56-6). Patients' food allergies should be noted on their medical records, because there may be risk of allergic reactions not only to food but also to some medications containing similar substances (Sampson et al., 2014).

Latex Allergy

Latex allergy—the allergic reaction to natural rubber proteins—has been implicated in rhinitis, conjunctivitis, contact dermatitis, urticaria, asthma, and anaphylaxis. The prevalence has been steadily declining, possibly because of the use of nonpowdered latex and latex-free gloves (Mayo Foundation for Medical Education and Research, 2015).

Natural rubber latex is derived from the sap of the rubber tree (*Hevea brasiliensis*). The conversion of the liquid rubber latex into a finished product entails the addition of more than 200 chemicals. The proteins in the natural rubber latex (Hevea proteins) or the various chemicals that are used in the manufacturing process are thought to be the source of the allergic reactions. Not all objects composed of latex have the same ability to stimulate an allergic response. For example, the antigenicity of latex gloves can vary widely depending on the manufacturing method used (AAAAI, 2015); (Mayo Foundation for Medical Education and Research, 2015).

Those at risk include 8% to 17% of health care workers, patients with atopic allergies or multiple surgeries, people working in factories that manufacture latex products, females, and 67% of patients with spina bifida (Fleisher et al., 2013). Because more food handlers, hairdressers, automobile mechanics, and police wear latex gloves, they are at risk for latex allergy. Patients are at risk for anaphylactic reactions as a result of contact with latex during medical treatments, especially surgical procedures. Food that has been handled by people wearing latex gloves may stimulate an allergic response. Cross-reactions have been reported in people who are allergic to certain food products, such as kiwis, bananas, pineapples, mangoes, passion fruit, avocados, and chestnuts (AAAAI, 2015); (Mayo Foundation for Medical Education and Research, 2015).

Routes of exposure to latex products can be cutaneous, percutaneous, mucosal, parenteral, or aerosol. Allergic reactions are more likely with parenteral or mucous membrane exposure but can also occur with cutaneous contact or inhalation. The most frequent source of exposure is cutaneous, which usually involves the wearing of natural latex gloves. The powder used to facilitate putting on latex gloves can become a carrier of latex proteins from the gloves; when the gloves are put on or removed, the particles become airborne and can be inhaled or settle on skin, mucous membranes, or clothing. Mucosal exposure can occur from the use of latex condoms, catheters, airways, and nipples. Parenteral exposure can occur from intravenous lines or hemodialysis equipment. In addition to latex-derived medical devices, many household items also contain latex. Examples of medical and household items containing latex and a list of alternative products are found in Table 56-5. It is estimated that more than 40,000 medical devices and nonmedical products contain latex. Chemical additives used in the manufacture of nonlatex gloves and other items have been associated with allergic symptoms, although these otherwise have a low potential to stimulate an allergic response (AAAAI, 2015); (Mayo Foundation for Medical Education and Research, 2015).

Clinical Manifestations

Many different types of reactions to latex are possible (see Table 56-6). Irritant contact dermatitis, a nonimmunologic

Chart 56-6 HOME CARE CHECKLIST

Managing Food Allergies

At the completion of education, the patient, caregiver, or both will be able to:

- State the impact of food allergies on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- Verbalize understanding of the need to maintain an allergen-free diet.
- Demonstrate reading of food labels to identify hidden allergens in food.
- Identify ways to manage an allergen-free diet when eating away from home.
- State the need to wear medical identification bracelet or necklace.
- List symptoms of food allergy.
- Demonstrate emergency administration of epinephrine.
- State the importance of replacing epinephrine when outdated.
- State the importance of prompt treatment of allergic reactions and health care follow-up.
- State how to reach primary provider with questions or complications.
- State time and date of follow-up appointments, testing.
- Verbalize ways to cope with stress successfully, plans for regular exercise, and rationale for obtaining adequate rest.
- Identify the need for health promotion, disease prevention, and screening activities.

ADLs, activities of daily living; IADLs, independent activities of daily living.

TABLE 56-5 Selected Products Containing Natural Rubber Latex and Latex-Free Alternatives

Products Containing Latex	Examples of Latex-Safe Alternatives[a]
Hospital Environment	
Ace bandage (brown)	Ace bandage, white all cotton
Adhesive bandages, Band-Aid dressing, Telfa	Cotton pads and plastic or silk tape, Active Strips (3M), DuoDERM
Anesthesia equipment	Neoprene anesthesia kit (King)
Blood pressure cuff, tubing, and bladder	Clean Cuff, single-use nylon or vinyl blood pressure cuffs or wrap with stockinette or apply over clothing
Catheters	All-silicone or vinyl catheters
Catheter leg bag straps	Velcro straps
Crutch axillary pads and hand grips, tips	Cover with cloth, tape
ECG pads	Baxter, Red Dot 3M ECG pads
Elastic compression stockings	Kendall SCD stockings with stockinette
Gloves	Derma Prene, neoprene, polymer, or vinyl gloves
IV catheters	Jelco, Deseret IV catheters
IV rubber injection ports	Cover Y-sites and ports; do not puncture. Use three-way stopcocks on plastic tubing.
Levin tube	Salem sump tube
Medication vials	Remove rubber stopper.
Penrose drains	Jackson-Pratt, Zimmer Hemovac drains
Prepackaged enema kits	Therevac, Fleet Ready-to-Use
Pulse oximeters	Nonin oximeters
Resuscitation bags	Laerdal, Puritan Bennett, *certain* Ambu
Stethoscope tubing	PVC tubing; cover with latex-free stockinette
Suction tubing	PVC (Davol, Laerdal)
Syringes—single use (Monoject, BD)	Terumo syringes, Abbott PCA Abboject
Tapes	Dermicel, Micropore
TheraBand	New Thera-band Exercisers, plastic tubing
Thermometer probes	Diatek probe covers
Tourniquets	X-Tourn straps (Avcor)
Home Environment	
Balloons	Mylar balloons
Condoms, diaphragms	Polyurethane products, Durex Avanti and Reality products (female condom)
Diapers, incontinence pads	Huggies, Always, *some* Attends
Feminine hygiene pads	Kimberly-Clark products
Wheelchair cushions	ROHO cushions, Sof Care bed/chair cushions

ECG, electrocardiogram; IV, intravenous; PVC, polyvinyl chloride.

[a]Confirmation is essential to verify that all items are latex free before using, especially if risk of latex allergy is present.

Adapted from American Academy of Allergy, Asthma, and Immunology (AAAAI). (2015). Anaphylaxis overview. Retrieved on 11/15/2015 at: www.aaaai.org; Australasian Society of Clinical Immunology and Allergy (ASCIA). (2015). Immunotherapy for treatment of allergy. Retrieved on 11/15/2015 at: allergy.org.au; Campbell, R. L., Li, J., Nicklas, R. A., et al. (2014). Emergency department diagnosis and treatment of anaphylaxis: A practice parameter. Annals of Allergy Asthma & Immunology, 113, 599–608; Centers for Disease Control and Prevention (CDC) (2014). Latex allergy: A prevention guide. Retrieved on 11/20/2015 at: www.cdc.gov/niosh/docs/98-113/default.html; Mayo Foundation for Medical Education and Research. (2015). Diseases and conditions: Latex allergy. Retrieved on 11/20/2015 at: www.mayoclinic.org/diseases-conditions/latex-allergy/basics/definition/CON-20024233

response, may be caused by mechanical skin irritation or an alkaline pH associated with latex gloves. Common symptoms of irritant dermatitis include erythema and pruritus. These symptoms can be eliminated by changing the brand of gloves or by using powder-free gloves. The use of hand lotion before donning latex gloves can worsen the symptoms, because lotions may leach latex proteins from the gloves, thus increasing skin exposure and the risk of developing true allergic reactions (Mayo Foundation for Medical Education and Research, 2015).

Delayed hypersensitivity to latex, a type IV reaction mediated by T cells in the immune system, is localized to the area of exposure and is characterized by symptoms of contact dermatitis, including vesicular skin lesions, papules, pruritus, edema, erythema, and crusting and thickening of the skin. These symptoms usually appear on the back of the hands. This reaction is thought to be caused by chemicals that are used in the manufacturing of latex products. It is the most common allergic reaction to latex. Although usually not life-threatening, delayed hypersensitivity reactions often require major changes in the patient's home and work environment to avoid further exposure. People who are sensitized to latex are at increased risk for development of type I allergic reactions (AAAAI, 2015); (Mayo Foundation for Medical Education and Research, 2015).

Immediate hypersensitivity, a type I allergic reaction, is mediated by the IgE mast cell system (Abbas et al., 2014). Symptoms can include rhinitis, conjunctivitis, asthma, and anaphylaxis. Clinical manifestations have a rapid onset and can include urticaria, wheezing, dyspnea, laryngeal edema, bronchospasm, tachycardia, angioedema, hypotension, and cardiac arrest.

Localized itching, erythema, or local urticaria within minutes after exposure to latex is often the initial symptom. Symptoms of subsequent reactions can include generalized urticaria, angioedema, rhinitis, conjunctivitis, asthma, and anaphylactic shock minutes after dermal or mucosal exposure to latex. An increasing number of people who are allergic to latex experience severe reactions characterized by generalized urticaria, bronchospasm, and hypotension.

Assessment and Diagnostic Findings

The diagnosis of latex allergy is based on the history and diagnostic test results (Mayo Foundation for Medical Education and Research, 2015). Sensitization is detected by skin testing;

TABLE 56-6 Types of Reactions to Latex

Type of Reaction	Cause	Signs/Symptoms	Treatment
Irritant contact dermatitis	Damage to skin because of irritation and loss of epidermoid skin layer; not an allergic reaction. Can be caused by excessive use of soaps and cleansers, repeated hand washing, inadequate hand drying, mechanical irritation (e.g., sweating, rubbing inside powdered gloves), exposure to chemicals added during the manufacturing of gloves, and alkaline pH of powdered gloves. Reaction may occur with first exposure, is usually benign, and is not life-threatening.	*Acute*: Redness, edema, burning, discomfort, itching *Chronic*: Dry, thickened, cracked skin	Referral for diagnostic testing Avoidance of exposure to irritant Thorough washing and drying of hands Use of powder-free gloves with more frequent changes of gloves Changing glove types Use of water- or silicone-based moisturizing creams, lotions, or topical barrier agents Avoidance of oil- or petroleum-based skin agents with latex products, because they cause breakdown of the latex product
Allergic contact dermatitis	Delayed hypersensitivity (type IV) reaction. Usually affects only area in contact with latex; reaction is usually to chemical additives used in the manufacturing process rather than to latex itself. Cause of reaction is T-cell–mediated sensitization to additives of latex. Reaction is not life-threatening and is far more common than a type I reaction. Slow onset; occurs 18–24 hours after exposure. Resolves within 3–4 days after exposure. More severe reactions may occur with subsequent exposures.	Pruritus, erythema, swelling, crusty thickened skin, blisters, other skin lesions	Referral for diagnosis (patch tests) and treatment Thorough washing and drying of hands Use of water- or silicone-based moisturizing creams, lotions, or topical barrier agents Avoidance of oil- or petroleum-based products unless they are latex compatible Avoidance of identified causative agent, because continued exposure to latex products in presence of breaks in skin may contribute to latex protein sensitization
Latex allergy	Type I IgE-mediated immediate hypersensitivity to plant proteins in natural rubber latex. In sensitized people, antilatex IgE antibody stimulates mast cell proliferation and basophil histamine release. Exposure can be through contact with the skin, mucous membranes, or internal tissues, or through inhalation of traces of powder from latex gloves. Severe reactions usually occur shortly after parenteral or mucous membrane exposure. People with any type I reaction to latex are at high risk for anaphylaxis. Local swelling, redness, edema, itching, and systemic reactions, including anaphylaxis, occur within minutes after exposure.	Rhinitis, flushing, conjunctivitis, urticaria, laryngeal edema, bronchospasm, asthma, severe vasodilation angioedema, anaphylaxis, cardiovascular collapse, death	Immediate treatment of reaction with epinephrine, fluids, vasopressors, and corticosteroids, and airway and ventilator support, with close monitoring for recurrence for the next 12–14 hours Prompt referral for diagnostic evaluation Treatment and diagnostic evaluation in latex-free environment Assessment of all patients for symptoms of latex allergy Educating patients and family members about the disorder and the importance of preventing future reactions by avoiding latex (e.g., wearing medical identification, carrying EpiPen)

IgE, immunoglobulin E.

serum-specific IgE, EIA, or ELISA; or the level of Hevea latex-specific IgE antibody in the serum. Testing for the chemicals found in the rubber production that makes latex is performed using the patch test. Skin patch testing is the preferred method for patients with contact allergies. The T.R.U.E. test and other skin tests should be performed only by clinicians who have expertise in their administration and interpretation and who have the necessary equipment available to treat local or systemic allergic reactions to the reagent (Habif, 2016).

Medical Management

The best treatment available for latex allergy is the avoidance of latex-based products, although avoidance is often difficult because of the widespread use of such products. Patients who have experienced an anaphylactic reaction to latex should be instructed to wear medical identification. Antihistamines and an emergency kit containing epinephrine should be provided to these patients, along with instructions about emergency management of latex allergy symptoms. Patients should be counseled to notify all health care workers, as well as local paramedic and ambulance companies, about their allergy. Warning labels can be attached to car windows to alert police and paramedics about the driver's or passenger's latex allergy in case of a motor vehicle crash. People with latex allergy should be provided with a list of alternative products and referred to local support groups; they are also urged to carry their own supply of nonlatex gloves.

People with type I latex sensitivity may be unable to continue to work if a latex-free work environment is not possible. This may occur with surgeons, dentists, operating room personnel, or intensive care nurses. Occupational implications for employees with type IV latex sensitivity are usually easier to manage by changing to nonlatex gloves and avoiding direct contact with latex-based medical equipment. Although latex-specific immunotherapy has been attempted, this method of treatment remains experimental.

Nursing Management

The nurse can assume a pivotal role in the management of latex allergies in both patients and staff. All patients should be asked

about latex allergy, although special attention should be given to those at particularly high risk (e.g., patients with spina bifida, patients who have undergone multiple surgical procedures). Every time an invasive procedure must be performed, the nurse should consider the possibility of latex allergies. Nurses working in operating rooms, intensive care units, short procedure units, and EDs need to pay particular attention to latex allergy. See Figure 4-1 in Chapter 4 for a latex allergy assessment form.

Although the type I reaction is the most significant of the reactions to latex, care must be taken in the presence of irritant contact dermatitis and delayed hypersensitivity reaction to avoid further exposure of the person to latex. Patients with latex allergy are advised to notify their health care providers and to wear medical identification. Patients must become knowledgeable about what products contain latex and what products are safe, nonlatex alternatives. They must also become knowledgeable about signs and symptoms of latex allergy and emergency treatment and self-injection of epinephrine in case of allergic reaction.

Nurses can be instrumental in establishing and participating in multidisciplinary committees to address latex allergy and to promote a latex-free environment. Latex allergy protocols and education of staff about latex allergy and precautions are important strategies to reduce this growing problem and to ensure assessment and prompt treatment of those affected by allergy to latex.

CRITICAL THINKING EXERCISES

1. You are the nurse working in a preoperative holding area. A 38-year-old patient tells you that she has had a reaction to latex in the past. What are the immediate nursing priorities in providing care to this patient? What assessment data are needed to determine if this patient has a latex allergy?
2. A 47-year-old postman presents to the ED complaining of difficulty breathing after being stung by a bee. He states that this has happened two other times in his recent past and seems to be worse each time. What are the priority interventions? What medication is the drug of choice for severe allergic reactions, and how is it given? Describe the strength of the evidence and criteria used to assess its strength.

REFERENCES

*Asterisk indicates nursing research.

Books

Abbas, A., Lichtman, A., & Pillai, S. (2014). Basic immunology functions and disorders of the immune system (4th ed.). Philadelphia, PA: Elsevier Saunders.

Arcangelo, V. P., & Peterson, A. (Eds.). (2013). Pharmacotherapeutics for advanced practice: A practical approach (3rd ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Fleisher, T., Shearer, W., Schroeder, H., et al. (2013). Clinical immunology (4th ed.). St Louis, MO: Elsevier.

Frandsen, G., & Pennington, S. (2014). Abrams's clinical drug therapy (10th ed.). Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkens.

Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Habif, T. (2016). Clinical dermatology a color guide to diagnosis and therapy (6th ed.). St Louis, MO: Elsevier.

Hodgson, B., & Kizior, R. (2014). Saunders nursing drug book. St Louis, MO: Elsevier.

Katzung, B., & Trevor, A. (2015). Basic & clinical pharmacology (13th ed.). New York: McGraw-Hill Education.

Pagana, K., & Pagana, T. (2013). Mosby's diagnostic & laboratory test reference (11th ed.). St Louis, MO: Elsevier

Turley, S. (2014). Medical language (3rd ed.). Saddle River, NJ: Pearson.

Journals & Electronic Documents

Albin, S., & Agarwal, S. (2014). Prevalence and characteristics of reported penicillin allergy in an urban outpatient population. Allergy and Asthma Proceedings, 35(6), 489–494.

American Academy of Allergy, Asthma, and Immunology (AAAAI). (2015). *Anaphylaxis overview*. Retrieved on 11/15/2015 at: www.aaaai.org

American Osteopathic College of Dermatology. (2015). *Urticaria*. Retrieved on 11/15/2015 at: www.aocd.org

Australasian Society of Clinical Immunology and Allergy (ASCIA). (2015). *Immunotherapy for treatment of allergy*. Retrieved on 11/15/2015 at: allergy.org.au

Baran, H., Ozcan, K., Selcuk, A., et al. (2014). Allergic rhinitis and its impact on asthma classification correlations. The Journal of Laryngology & Otology,128, 431–437.

Bernstein, J., Lang, D., Khan, D., et al. (2014). The diagnosis and management of acute and chronic urticaria: 2014 update. Journal of Allergy and Clinical Immunology in Practice, 133(5), 1270–1277.

Bleier, B. (2015). *Nasal/sinus irrigation*. Retrieved on 11/15/2015 at: care.american-rhinologic.org

Campbell, R. L., Li, J., Nicklas, R. A., et al. (2014). Emergency department diagnosis and treatment of anaphylaxis: A practice parameter. Annals of Allergy Asthma & Immunology, 113, 599–608.

Centers for Disease Control and Prevention (CDC). (2014). *Latex allergy: A prevention guide*. Retrieved on 11/20/2015 at: www.cdc.gov/niosh/docs/98-113/default.html

Chandrika. D (2017). Allergic rhinitis in India: An overview. International Journal of Otorhinolaryngology and Head and Neck Surgery, 3 (1), 1-6.

Cicardi, M., & Zuraw, B. (2015). *Hereditary angioedema: Treatment of acute attacks*. Retrieved on 11/15/2015 at: www.uptodate.com/contents/hereditary-angioedema-treatment-of-acute-attacks

Ciccarelli, F., De Martinis, M., & Ginaldi, L. (2014). An update on autoinflammatory diseases. Current Medical Chemistry, 21(3),261–269.

Fleischer, D., Sicherer, S., Greenhawt, M., et al. (2015). Consensus communication on early peanut introduction and the prevention of peanut allergy in high risk infants. Journal of Allergy and Immunology, 136(2), 258–261.

Fonacier, L., Bernstein, D., Pacheco, K., et al. (2015). Contact dermatitis: A practice parameter-update 2015. Journal of Allergy and Clinical Immunology in Practice, 3, S1–S39.

Herro, E., & Jacob, S. (2014). An update on pediatric allergic contact dermatitis patch testing for common allergens. Consultant for Pediatrics, 13(8), 350–355.Retrieved on November 2015, from Consultant for Pediatrics at: www.pediatricsconsultant360.com

Hwang, P., & Patel, Z. (2015). *Acute sinusitis and rhinosinusitis in adults: Treatment*. Retrieved on November 2015 at: www.uptodate.co

Lehrer, E., Mullol, J., Agredo, F., et al (2014). Management of chronic rhinitis in asthma patients: Is there still a debate. Current Allergy and Asthma Report, 14(6), 1–6.

Link, M.S., Berkow, L.C., Kudenchuk, P.J., et al. (2015). Part 7: Adult advanced cardiovascular life support: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation, 132(Suppl 2), S444–S464

Ludman, S., & Boyle, R. (2015). Stinging insect allergy: Current perspectives on venom immunotherapy. Journal of Allergy and Asthma, 2015(8), 75–86.

Mayo Foundation for Medical Education and Research. (2015). *Diseases and conditions: Latex allergy*. Retrieved on 11/20/2015 at: www.mayoclinic.org/diseases-conditions/latex-allergy/basics/definition/CON-20024233

National Institute of Allergy and Infectious Disease (NIAID). (2013). *The national asthma education and prevention program*. Retrieved on 11/20/2015 at: www.nhlbi.nih.gov/about/org/naepp/

Oppenheimer, J., Durham, S., Nelson, H., et al. (2014). Allergy diagnostic testing. Retrieved on 11/20/2015 at: www.worldallergy.org

Perez-Riverol, A., Justo-Jacomini, D., de Lima Zollner, R., et al. (2015). Facing hymenoptera venom allergy: From natural to recombinant allergens. Toxins, 7(7), 2551–2570.

Portnoy, J. (2015). *World allergy*. Retrieved on 11/20/2015 at: www.worldallergy.org

Rosenfeld, R., Piccirillo, J. F., Chandrasekhar, S., et al. (2015). Clinical practice guideline (Update): Adult sinusitis. Otolaryngology-Head and Neck Surgery, 152(2S), S1–S39.

Sampson, H., Aceves, S., Brock, S., et al. (2014). Food allergy: A practice parameter update-2014. Journal of Allery and Clinical Immunology, 134(5), 1025.e1–e43.

Senti, G., von Moos, S., Graf, N., et al. (2015). Determinants of efficacy and safety in epicutaneous allergen immunotherapy: Summary of three clinical trials. European Journal of Allergy and Clinical Immunology, 70(6), 707–710.

Sheikh, J. (2015). *Allergic rhinitis treatment and management*. Retrieved on 11/15/15 at: emedicine.medscape.com/article/134825-treatment

Resources

American Academy of Allergy, Asthma, and Immunology (AAAAI), www.aaaai.org

American College of Allergy, Asthma, and Immunology (ACAAI), www.acaai.org

Asthma and Allergy Foundation of America (AAFA), www.aafa.org

Centers for Disease Control and Prevention (CDC), www.cdc.gov

Food Allergy Research Education (FARE), www.foodallergy.org

Mayo Foundation for Medical Education and Research, www.mayoclinic.org

MD Junction, Urticaria Support Group, www.mdjunction.com/urticaria

National Institute of Allergy and Infectious Diseases, www.niaid.nih.gov

Occupational Safety and Health Administration (OSHA), www.osha.gov

CHAPTER 57

Assessment and Management of Patients with Rheumatic Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Explain the pathophysiology of rheumatic diseases.
2. Describe the assessment and diagnostic findings seen in patients with rheumatic diseases or disorders.
3. Use the nursing process as a framework for the care of patients with rheumatic disorders.
4. Describe the systemic effects of a connective tissue disease.
5. Devise an education plan for the patient with newly diagnosed rheumatic disease.
6. Identify modifications in interventions to accommodate changes in patients' functional ability that may occur with disease progression.

GLOSSARY

ankylosis: fixation or immobility of a joint
arthritis: inflammation of a joint
arthroplasty: replacement of a joint
cytokines: proteins that can be produced by leukocytes that are vital to regulation of hematopoiesis, apoptosis, and immune responses
exacerbation: period when disease symptoms occur or increase
osteophyte: a bony outgrowth or protuberance; bone spur
pannus: proliferation of newly formed synovial tissue infiltrated with inflammatory cells
remission: period when disease symptoms are reduced or absent
rheumatic diseases: numerous disorders affecting skeletal muscles, bones, cartilage, ligaments, tendons, and joints
rheumatoid arthritis: a systemic autoimmune disease with symmetric arthritic manifestations and multiple extra-articular features
subchondral bone: bony plate that supports the articular cartilage
tophi: accumulation of crystalline deposits in articular surfaces, bones, soft tissue, and cartilage

Introduction

The rheumatic diseases encompass autoimmune, degenerative, inflammatory, and systemic conditions that affect the joints, muscles, and soft tissues of the body. Rheumatic diseases most commonly manifest the clinical features of arthritis (inflammation of a joint) and pain. There are more than 100 types of rheumatic diseases. The problems caused by rheumatic diseases include limitations in mobility and activities of daily living, pain, fatigue, altered self-image, and sleep disturbances, as well as systemic effects that can lead to organ failure and death. An understanding of rheumatic diseases and their effects on a patient's function and well-being is essential to developing an appropriate plan of nursing care.

Rheumatic Diseases

An estimated 52.5 (22.7%) million adults in the United States have self-reported arthritis or other rheumatologic disease. Approximately 22.7 million (43.2% of those diagnosed with arthritis) have arthritis-attributable activity limitation. By 2030, an estimated 67 million (25%) adults will have arthritis or a rheumatologic condition, and an estimated 25 million adults (37%) will report arthritis-attributable activity limitations (Barbour, Helmick, Theis, et al., 2013). Based on a large population study done with 51,741 samples across fifteen centers in India, the prevalence of rheumatoid arthritis (RA) is estimated to be 0.34% (Chopra, Ghorpade, Sarmukkadam, et al., 2012). In the state of Rajasthan, the prevalence was high (0.80%). Even though the prevalence of RA is less, the overall disease burden for the country is high with more than 5 million people suffering from RA.

Arthritis and other rheumatologic diseases and the physical limitations that occur with them are becoming more prominent and a larger public health issue, which can be attributed to the older adults.

Rheumatologic disease processes affect males and females of all ages and ethnic groups. Some disorders are more likely to occur at a particular time of life or to affect one gender more often than the other. In general, women are two to nine times more commonly affected by rheumatologic diseases than men (Barbour et al., 2013). The onset of these conditions may be acute or insidious, with a course possibly marked by periods of remission (a period when disease symptoms are reduced or absent) and exacerbation (a period when symptoms occur or increase). Treatment can be simple, aimed at localized relief, or it can be complex, directed toward relief of systemic effects. Permanent changes and disability may result from these disorders.

Nurses need to understand the classification of rheumatic diseases. One system is to classify disease as either monoarticular (affecting a single joint) or polyarticular (affecting multiple joints). Another system is to classify the disease as either inflammatory or noninflammatory. Conditions that may secondarily affect the musculoskeletal structure are also considered in disease classification.

Pathophysiology

Each of the rheumatologic diseases exhibits unique pathophysiologic features. Three distinct characteristics of pathophysiology include inflammation, autoimmunity, and degeneration.

Inflammation

Inflammation is a complex physiologic process mediated by the immune system that occurs in response to harmful stimuli like damaged cells or antigens, which may include pathogens (e.g., viruses, bacteria). Inflammation is meant to protect the body from insult by removing the triggering antigen or event. In response to a triggering episode, the antigen stimulus activates the body's immune system to form antibodies like monocytes and T lymphocytes (also referred to as T cells). Next, the immunoglobulin antibodies form immune complexes with antigens. Phagocytosis of the immune complexes is initiated, generating an inflammatory reaction (joint effusion, pain, and edema) (see Fig. 57-1). Phagocytosis produces chemicals such as leukotrienes and prostaglandins. Leukotrienes contribute to the inflammatory process by attracting other white blood cells to the area. Prostaglandins act as modifiers to inflammation. In some cases, they increase inflammation; in other cases, they decrease it. Leukotrienes and prostaglandins produce enzymes such as collagenase that break down collagen, which is a vital part of a normal joint. The release of these enzymes in the joint causes edema and proliferation of synovial membrane. In patients with chronic inflammation, the immune response can deviate from normal. Instead of resolution of swelling and joint pain once the triggering event has subsided, pannus (proliferation of newly formed synovial tissue infiltrated with inflammatory cells) formation occurs. Destruction of the joint's cartilage and erosion of bone soon follow.

The immunologic inflammatory process begins when antigens are presented to T lymphocytes, leading to a proliferation of T and B cells. B cells (also referred to as plasma cells) are a source of antibody-forming cells. In response to specific antigens, plasma cells produce and release antibodies. Antibodies combine with corresponding antigens to form pairs, or immune complexes. The immune complexes build up and are deposited in synovial tissue or other organs in the body, triggering the inflammatory reaction that can ultimately damage the involved tissue.

Autoimmunity

A hallmark of rheumatologic diseases is autoimmunity, where the body mistakenly recognizes its own tissue as a foreign antigen. Autoimmunity leads to destruction of tissue via the same inflammatory process as discussed earlier, along with chronic and long-standing pain. Although focused in the joints, inflammation and autoimmunity also involve other areas. The blood vessels (vasculitis and arteritis), lungs, heart, and kidneys may be affected by the autoimmunity and inflammation. See Chapter 54 for more information on autoimmune disease. A large group of genes, called *human leukocyte antigen* (HLA) genes, has been linked to the immune response and the development of multiple rheumatologic diseases (Di Lorenzo, 2015).

Degeneration

In degenerative rheumatic diseases, inflammation also occurs, but as a secondary process. Although the cause of degeneration of the articular cartilage is poorly understood, the process is known to be metabolically active and therefore is more accurately called *degradation.* One theory of degradation is that genetic or hormonal influences, mechanical factors, and prior joint damage cause cartilage failure. Degradation of cartilage ensues, and increased mechanical stress on bone ends causes stiffening of bone tissue. Another theory is that bone stiffening occurs and results in increased mechanical stress on cartilage, which in turn initiates the processes of degradation. See Chapter 35 for more information on the structure and function of the articular system.

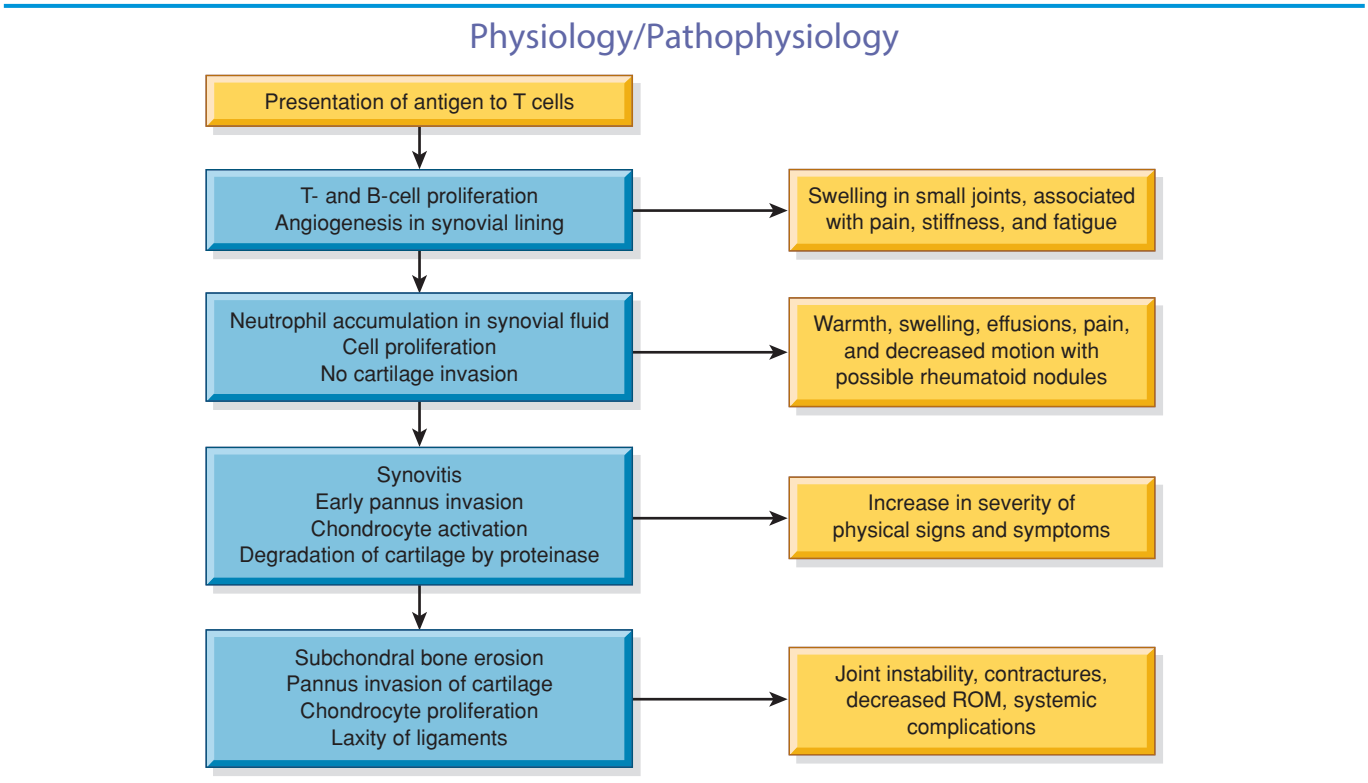


Figure 57-1 • Pathophysiology and associated physical signs of rheumatoid arthritis. ROM, range of motion.

Clinical Manifestations

The most common symptom in the rheumatic diseases is pain. Other common symptoms include joint swelling, limited movement, stiffness, weakness, and fatigue.

Assessment and Diagnostic Findings

Assessment begins with a general health history, which includes the onset of symptoms and how they evolved, family history, past health history, and any other contributing factors. Because many of the rheumatic diseases are chronic conditions, the health history should also include information about the patient's perception of the problem, previous treatments and their effectiveness, the patient's support systems, and the patient's current knowledge base and the source of that information. A complete health history is followed by a complete physical assessment (see Chapter 3).

Assessment for rheumatic diseases combines the physical examination with a functional assessment. Inspection of the patient's general appearance occurs during the initial contact. Gait, posture, and general musculoskeletal size and structure are observed. Gross deformities and abnormalities in movement are noted. The symmetry, size, and contour of other connective tissues, such as the skin and adipose tissue, are also noted and recorded. Chart 57-1 outlines the important areas for consideration during the physical assessment. The functional assessment is a combination of history (what the patient reports that he or she can and cannot do) and examination (observation of activities, in which the patient demonstrates what he or she can and cannot do, such as dressing and getting in and out of a chair). Observation also includes the adaptations and adjustments the patient may have made (sometimes without awareness)—for example, with shoulder or elbow involvement, the person may bend over to reach a fork rather than raising the fork to the mouth.

Chart 57-1 ASSESSMENT

Assessing for Rheumatic Disorders

In addition to the head-to-toe assessment or systems review, the following are important areas of consideration to be noted when performing the complete physical assessment of a patient with a known or suspected rheumatic disorder.

Manifestation	Significance
Skin (inquire and inspect)	
Rash, lesions	Associated with systemic lupus erythematosus (SLE) vasculitis, adverse effect of medication
Increased bruising	Associated with several rheumatic diseases and adverse effect of medication
Erythema	Sign of inflammation
Thinning	Adverse effect of medication
Warmth	Sign of inflammation
Photosensitivity	Associated with SLE, dermatomyositis, adverse effect of medication
Hair (inquire and inspect)	
Alopecia or thinning	Associated with rheumatic diseases or adverse effect of medication
Eye (inquire and inspect)	
Dryness, grittiness	Associated with Sjögren's syndrome (commonly occurring with rheumatoid arthritis [RA] and SLE)
Decreased acuity or blindness	Associated with temporal arteritis, medication complications
Cataracts	Adverse effect of medication
Decreased peripheral vision	Adverse effect of medication
Conjunctivitis, uveitis	Associated with ankylosing spondylitis and Reiter's syndrome
Ear (inquire)	
Tinnitus	Adverse effect of medication
Decreased acuity	Adverse effect of medication
Mouth (inquire and inspect)	
Buccal, sublingual lesions	Associated with vasculitis, dermatomyositis, adverse effect of medication
Altered sense of taste	Adverse effect of medication
Dryness	Associated with Sjögren's syndrome
Dysphagia	Associated with myositis
Difficulty chewing	Associated with decreased range of motion of jaw
Chest (inspect and inquire)	
Pleuritic pain	Associated with RA and SLE
Decreased chest expansion	Associated with ankylosing spondylitis
Activity intolerance (dyspnea)	Associated with pulmonary hypertension in scleroderma
Cardiovascular system (inquire, inspect, palpate)	
Blanching of fingers on exposure to cold	Associated with Raynaud's phenomenon
Peripheral pulses	Deficit may indicate vascular involvement or edema associated with medication effect or rheumatic diseases, especially SLE or scleroderma

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Abdomen (inquire and palpate)	
Altered bowel habits	Associated with scleroderma, spondylosis, ulcerative colitis, decreased physical mobility, medication effect
Nausea, vomiting, bloating, and pain	Adverse effect of medication
Weight change (measure)	Associated with RA (decreased), adverse effect of medication (increased or decreased)
Genitalia (inquire and inspect)	
Dryness, itching	Associated with Sjögren's syndrome
Abnormal menses	Adverse effect of medication
Altered sexual performance	Fear of pain (or of pain caused by partner) and limitation of motion may affect sexual mobility.
Hygiene	Poor hygiene may be related to limitations in activities of daily living.
Urethritis, dysuria	Associated with ankylosing spondylitis and Reiter's syndrome
Lesions	Associated with vasculitis
Neurologic (inquire and inspect)	
Paresthesias of extremities; abnormal reflex pattern	Nerve compressions (e.g., carpal tunnel syndrome, spinal stenosis)
Headaches	Associated with temporal arteritis, adverse effect of medication
Musculoskeletal (inspect and palpate)	
Joint redness, warmth, swelling, tenderness, deformity—location of first joint involved, pattern of progression, symmetry, acute vs. chronic nature	Signs of inflammation
Joint range of motion	Decreased range of motion may indicate severity or progression of disease.
Surrounding tissue findings	
Muscle atrophy, subcutaneous nodules, popliteal cyst	Extra-articular manifestations
Muscle strength (grip)	Muscle strength decreases with increased disease activity.

Laboratory Studies

In Table 57-1, some of the most common laboratory studies are listed with their corresponding normal ranges and significance. Many of the tests require special laboratory techniques and may not be performed in every health care facility. The primary provider determines which tests are necessary based on symptoms, stage of disease, cost, and likely benefit. In some instances, tests are used to monitor the course of the disease.

Other Diagnostic Studies

Imaging studies commonly used for patients with rheumatic diseases include x-ray studies, computed tomography (CT) scans, magnetic resonance imaging (MRI) scans, and arthrography. See Chapter 35 for further information about these and other diagnostic studies.

Medical Management

The chronic nature of rheumatic conditions requires cooperation between the patient and the provider. The patient needs to understand the disease process and to be active in making good decisions for their care. Patient education regarding the disease process and treatment options is imperative to enable the patient to make informed decisions regarding their care. Management of rheumatologic diseases is based on the patient's symptom self-assessment, quality of life, and objective assessment by the provider (Schur & Moreland, 2016). Table 57-2 outlines goals and strategies for care of the patient with rheumatic diseases.

Pharmacologic Therapy

Medications are used with the rheumatic diseases to manage symptoms, to control inflammation, and, in some instances, to modify the disease. Useful medications include the salicylates, nonsteroidal anti-inflammatory drugs (NSAIDs), and both biologic and nonbiologic disease-modifying antirheumatic drugs (DMARDs). As their name suggests, DMARDs have the ability to suppress the autoimmune response; alter disease progression; and stop or decrease further tissue damage on the joints, cartilage, and organs. DMARDs have been found to halt the progression of bone loss and destruction and can induce remission (Carter, Patty-Resk, Ruffing, et al., 2015). Nonbiologic DMARDs are thought to reduce proinflammatory cytokines (cell signaling proteins) and increase anti-inflammatory cytokines. Biologic DMARDs, in contrast, have been specifically engineered to target a certain cell or molecule within the immune system to treat the specific rheumatologic condition. Specific biologic DMARDs target tumor necrosis factor alpha (TNF-α), B cells, T cells, interleukin 1 (IL-1), and interleukin 6 (IL-6). Table 57-3 reviews commonly used medications.

Controlling the inflammation related to the disease process helps manage pain, but this is often a delayed response. Nonopioid medications are often used for pain management, especially early in the treatment program, until other measures can be instituted.

Nonpharmacologic Pain Management

Nonpharmacologic methods of pain management are important. Heat applications are helpful in relieving pain, stiffness, and

TABLE 57-1 Common Blood Studies for Rheumatic Diseases

Test	Normal Value	Significance
Serum		
Creatinine		
Metabolic waste excreted through the kidneys	0.7–1.4 mg/dL (62–124 mcmol/L)	Increase may indicate kidney damage in SLE, scleroderma, and polyarteritis.
Erythrocyte Count		
Measures circulating erythrocytes	*Men*: 4,600,000–6,200,000/mm^3 ($4.6–6.2 \times 10^{12}$/L) *Women*: 4,200,000–5,400,000/mm^3 ($4.2–5.4 \times 10^{12}$/L)	Decrease can be seen in RA, SLE.
Erythrocyte Sedimentation Rate (ESR)		
Measures the rate at which RBCs settle out of unclotted blood in 1 hour	Westergren: Men under 50 years: <15 mm/hr Men over 50 years: <20 mm/hr Women under 50 years: <25 mm/hr Women over 50 years: <30 mm/hr	Increase is usually seen in inflammatory connective tissue diseases. An increase indicates rising inflammation, resulting in clustering of RBCs, which makes them heavier than normal. The higher the ESR, the greater the inflammatory activity.
Hematocrit		
Measures the size, capacity, and number of cells present in blood	*Men*: 42%–52% *Women*: 35%–47%	Decrease can be seen in chronic inflammation (anemia of chronic disease); also, blood loss through GI bleed.
White Blood Cell Count		
Measures circulating leukocytes	4,500–11,000 cells/mm^3	Decrease may be seen in SLE.
VDRL (Venereal Disease Research Laboratory)		
Measures antibody to syphilis	Nonreactive	False-positive results are sometimes found with SLE.
Uric Acid		
Measures level of uric acid in serum	2.5–8 mg/dL (0.15–0.5 mmol/L)	Increase is seen with gout. During acute flare, levels may be normal. After flare has subsided, levels will be elevated in gout.
Serum Immunology		
Antinuclear Antibody (ANA)		
Measures antibodies that react with a variety of nuclear antigens If antibodies are present, further testing determines the type of ANA circulating in the blood (anti-DNA, anti-RNP).	Negative Healthy adults may also have a positive ANA.	Positive test may be associated with SLE, RA, scleroderma, Raynaud's disease, Sjögren's syndrome, necrotizing arteritis. The higher the titer, the greater the inflammation. The pattern of immunofluorescence (speckled, homogeneous, or nucleolar) helps determine the diagnosis.
Anti-DNA, DNA Binding		
Titer measurement of antibody to double-stranded DNA	Negative	High titer is seen in SLE; increases in titer may indicate an increase in disease activity.
Complement Levels—C3, C4		
Complement is a protein substance that binds with antigen–antibody complexes for the purpose of lysis. When the number of complexes increases markedly, complement is used for lysis, thus depleting the amount available in the blood.	*C3*: 80–170 mg/dL (0.8–1.7 g/L) *C4*: 18–51 mg/dL (180–510 mg/L)	Decrease may be seen in RA and SLE. Decrease indicates autoimmune and inflammatory activity.
C-Reactive Protein (CRP)		
Shows presence of abnormal glycoprotein due to inflammatory process	<1 mg/dL (<10 mg/L)	A positive reading indicates active inflammation.
Immunoglobulin Electrophoresis		
Measures the values of immunoglobulins	*IgA*: 80–400 mg/dL (0.8–4 g/L) *IgG*: 600–1,800 mg/dL (6–18 g/L) *IgM*: 55–250 mg/dL (0.55–2.5 g/L)	Increased levels are found in people who have autoimmune disorders.
Rheumatoid Factor (RF)		
Determines the presence of abnormal antibodies seen in connective tissue disease	Negative	Positive titer >1:80 Present in 80% of those with RA Positive RF may also suggest SLE, Sjögren's syndrome, or mixed connective tissue disease. The higher the titer (number at right of colon), the greater the inflammation.
Tissue Typing		
HLA-B27 Antigen		
Measures presence of HLA antigens, which are used for tissue recognition	Negative	Found in 80%–90% of those with ankylosing spondylitis and Reiter's syndrome

DNA, deoxyribonucleic acid; GI, gastrointestinal; IgA, immunoglobulin A; IgG, immunoglobulin G; IgM, immunoglobulin M; HLA, human leukocyte antigen; RA, rheumatoid arthritis; ; RNP, ribonucleoprotein; RBCs, red blood cells; SLE, system lupus erythematosus.

Adapted from Fischbach, F., & Dunning, M. B. (2015). A manual of laboratory and diagnostic tests (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

TABLE 57-2 Management Goals and Strategies for Rheumatic Diseases

Goals	Management Strategies
Suppress inflammation and the autoimmune response	Optimize pharmacologic therapy (anti-inflammatory and disease-modifying agents).
Control pain	Protect joints; ease pain with splints, thermal modalities, relaxation techniques.
Maintain or improve joint mobility	Implement exercise programs for joint motion, muscle strengthening, weight loss as appropriate, and overall health.
Maintain or improve functional status	Make use of adaptive devices and techniques.
Increase patient's knowledge of disease process	Provide and reinforce patient education.
Promote self-management by patient adherence with the therapeutic regimen	Emphasize compatibility of therapeutic regimen and lifestyle.

muscle spasm. Superficial heat may be applied in the form of warm tub baths or showers and warm moist compresses. Paraffin baths (dips), which offer concentrated heat, are helpful to patients with wrist and small-joint involvement. Maximum benefit is achieved within 20 minutes after application. More frequent use for shorter lengths of time is most beneficial. Therapeutic exercises can be carried out more comfortably and effectively after heat has been applied.

Devices such as braces, splints, and assistive devices for ambulation (e.g., canes, crutches, walkers) ease pain by limiting movement or stress from putting weight on painful joints. Acutely inflamed joints can be rested by applying splints to limit motion. Splints also support the joint to relieve spasm. Canes and crutches can relieve stress from inflamed and painful weight-bearing joints while promoting safe ambulation. Cervical collars may be used to support the weight of the head and limit cervical motion. A metatarsal bar or special pads may be put into the patient's shoes if foot pain or deformity is present. A combination of methods may be required, because different methods often work better at different times.

TABLE 57-3 Selected Medications Used in Rheumatic Diseases

Medication	Action, Use, and Indication	Nursing Considerations
Salicylates		
Acetylated: Aspirin *Nonacetylated*: Choline trisalicylate (Arthropan, Trilisate), salsalate (Disalcid), sodium salicylate	*Action*: Anti-inflammatory, analgesic, antipyretic Acetylated salicylates are platelet aggregation inhibitors Anti-inflammatory doses will produce blood salicylate levels of 20–30 mg/dL	Administer with meals to prevent gastric irritation. Assess for tinnitus, gastric intolerance, GI bleeding, and purpura. Monitor for possible confusion in the older adult.
Nonsteroidal Anti-inflammatory Drugs (NSAIDs)		
Diclofenac (Voltaren), diflunisal (Dolobid), etodolac (Lodine), flurbiprofen (Ansaid), ibuprofen (Motrin), ketoprofen (Orudis, Oruvail), meclofenamate (Meclomen), meloxicam (Mobic), nabumetone (Relafen), naproxen (Naprosyn), oxaprozin (Daypro), piroxicam (Feldene), sulindac (Clinoril), tolmetin sodium (Tolectin) *COX-2 enzyme blockers*: celecoxib (Celebrex)	*Action*: Anti-inflammatory, analgesic, antipyretic, platelet aggregation inhibitor Anti-inflammatory effect occurs 2–4 weeks after initiation All NSAIDs are useful for short-term treatment of acute gout attack NSAIDs are an alternative to salicylates for first-line therapy in several rheumatic diseases *Action*: Inhibit only COX-2 enzymes, which are produced during inflammation, and spare COX-1 enzymes, which can be protective to the stomach	Administer NSAIDs with food. Monitor for GI, CNS, cardiovascular, renal, hematologic, and dermatologic adverse effects. Avoid salicylates; use acetaminophen/paracetamol for additional analgesia. Watch for possible confusion in older adults. Monitoring is the same as for other NSAIDs. Increased risk of cardiovascular events, including myocardial infarction and stroke Appropriate for older adults and patients who are at high risk for gastric ulcers
Disease-Modifying Antirheumatic Drugs (DMARDs)		
Antimalarials: Hydroxychloroquine (Plaquenil), chloroquine (Aralen)	*Action*: Anti-inflammatory, inhibit lysosomal enzymes Slow acting; onset may take 2–4 months. May be used in conjunction with other DMARD therapy. Useful in RA and SLE	Administer concurrently with NSAIDs. Assess for visual changes, GI upset, skin rash, headaches, photosensitivity, bleaching of hair. Emphasize need for ophthalmologic examinations (every 6–12 months).
Janus Kinase (JAK) inhibitors (Xeljanz)	*Action*: Enters the cell and binds to the active JAK site, inhibits autophosphorylation and JAK activation that inhibits cytokine production. May be used in combination with methotrexate or other nonbiologic DMARDs. May also be used as monotherapy	Administer twice a day. Do not administer with biologic DMARDs or potent immunosuppressants. Monitor lipids 4–8 weeks following initiation of therapy. Monitor liver enzymes routinely.
Sulfasalazine (Azulfidine)	*Action*: Anti-inflammatory, reduces lymphocyte response, inhibits angiogenesis Useful in RA, seronegative spondyloarthropathies	Administer concurrently with NSAIDs. Do not use in patients with allergy to sulfa medications or salicylates. Emphasize adequate fluid intake. Assess for GI upset, skin rash, headache, liver abnormalities, anemia.

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Immunosuppressives: Methotrexate (Rheumatrex), azathioprine (Imuran), cyclophosphamide (Cytoxan)	*Action*: Nonbiologic immune suppression, affect DNA synthesis and other cellular effects Have teratogenic potential; azathioprine and cyclophosphamide reserved for more aggressive or unresponsive disease Methotrexate is generally the first-line agent for RA treatment; also useful in SLE. Methotrexate may be given orally or by intramuscular or subcutaneous injection	Assess for bone marrow suppression, GI ulcerations, skin rashes, alopecia, bladder toxicity, increased infections. Monitor CBC, liver enzymes, creatinine at 6 weeks after initiation, then every 2–3 months or accordingly. Advise patient of contraceptive measures because of teratogenicity.
Cyclosporine (Neoral)	*Action*: Nonbiologic immune suppression by inhibiting T lymphocytes Used for severe, progressive RA, unresponsive to other DMARDs Used in combination with methotrexate	Assess slow dose titration upward until response noted or toxicity occurs. Assess for toxic effects, such as bleeding gums, fluid retention, hair growth, tremors. Monitor blood pressure and renal function (creatinine) every 2 weeks until stable.
Immunomodulators		
Pyrimidine synthesis inhibitor: Leflunomide (Arava)	*Action*: Nonbiologic with antiproliferative and anti-inflammatory effects; used in moderate to severe RA May be used alone or in combination with other DMARDs	Long half-life; requires loading dose followed by daily administration. Assess for diarrhea, hair loss, skin rash, mouth sores. Monitor liver function tests. Contraindicated in pregnancy and breast-feeding Given orally
TNF blocking agents: Adalimumab (Humira), certolizumab pegol (Cimzia), etanercept (Enbrel), infliximab (Remicade), golimumab (Simponi)	*Action*: Biologic response modifier that binds to TNF, a cytokine involved in inflammatory and immune responses. Used in moderate to severe RA. Can be used alone or with methotrexate or other nonbiologic DMARDs. Adalimumab is given by subcutaneous injection every 2 weeks, but may be used every week if efficacy not reached. Certolizumab pegol is given by subcutaneous injection every 2 weeks. Etanercept is given by subcutaneous injection weekly. Infliximab is given intravenously over 2 hours or more. Medication must be refrigerated Golimumab is given by subcutaneous injection once a month. Golimumab SC is a second alternative that is administered intravenously every 8 weeks after initial 2 loading doses	Patient should be tested for tuberculosis before beginning this medication. Educate patient about subcutaneous self-injection. Monitor for injection site reactions. Educate patient about increased risk for infection and to withhold medication if fever occurs. Notify provider if any illness or infection occurs and medication is held.
T-cell costimulation modulator: Abatacept (Orencia)	*Action*: Blocks one of the pathways needed to fully activate T cells, decreasing inflammatory and immunologic responses. Used in moderate to severe RA unresponsive to TNF inhibitors. Used with methotrexate or DMARDs other than TNF inhibitors or anakinra	Administered IV initially, then transitions to subcutaneous dosage once weekly. Educate patient about subcutaneous self-injections given daily. Monitor for injection site reactions. Educate patient about increased risk of infection and to withhold medication if fever occurs. IV infusions are given every 4 weeks over 30-minute infusion.
B-cell production blocker: Rituximab (Rituxan)	*Action*: Binds to B-lymphocyte CD20 surface antigens. Used in refractory RA in patients with inadequate response to TNF antagonist. Given with methotrexate	Rituximab is given as two 1,000-mg doses via IV infusion separated by 2 weeks. Given on weeks 0 and 2, and then subsequent doses are infused 24 weeks later or based on clinical diagnosis (commonly given every 6 months). Premedicate with acetaminophen/paracetamol, antihistamine, and methylprednisolone (Solu-Medrol) 30 minutes prior to infusion of rituximab. Educate patient about increased risk of infection.
Human IL-1 receptor antagonist: Anakinra (Kineret)	*Action:* Blocks IL-1 receptors, decreasing inflammatory and immunologic responses. Used in moderate to severe RA. Can be used alone or with methotrexate or DMARDs other than TNF-blocking agents	Given daily by subcutaneous injection. Educate patient about subcutaneous self-injections given daily. Medication must be refrigerated. Monitor for injection site reactions. Educate patient about increased risk of infection and to withhold medication if fever occurs.

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Human IL-6 receptor antagonist: Tocilizumab (Actemra)	*Action*: Binds to and inhibits IL-6 receptors, decreasing inflammatory and immunologic responses. Can be used alone or with methotrexate or in combination with other nonbiologic DMARDs	Administered IV every 4 weeks. Educate patient about increased risk of infection.
Corticosteroids		
Prednisone, prednisolone, hydrocortisone	*Action*: Anti-inflammatory. Used for shortest duration and at lowest dose possible to minimize adverse effects. Useful for unremitting RA, SLE, polymyalgia rheumatica, myositis, arteritis Fast acting; onset in days Intra-articular injections useful for joints unresponsive to NSAIDs	Assess for toxicity: Cataracts, GI irritation, hyperglycemia, hypertension, fractures, avascular necrosis, hirsutism, psychosis. Joints most amenable to injections include ankles, knees, hips, shoulders, and hands. Repeated injections can cause joint damage. Use caution in patients diagnosed with diabetes, due to effects causing elevation in blood sugar.
Topical Analgesics		
Capsaicin (Zostrix)	*Action*: Analgesic	Instruct patient to apply sparingly, avoid areas of open skin, and avoid contact with eyes and mucous membranes. Wash hands carefully after application. Assess for local skin irritation.

CBC, complete blood count; CNS, central nervous system; COX, cyclooxygenase; GI, gastrointestinal; IL-1, interleukin 1; IL-6, interleukin 6; IM, intramuscular; IV, intravenous; RA, rheumatoid arthritis; SLE, systemic lupus erythematosus; TNF, tumor necrosis factor; WBCs, white blood cells.

Adapted from Karch, A. (2014). Lippincott's nursing drug guide. Philadelphia, PA: Lippincott Williams & Wilkins.

Exercise and Activity

The ongoing nature of most rheumatic diseases makes it important to maintain and, when possible, improve joint mobility and overall functional status. Appropriate programs of exercise have been shown to decrease pain and improve function (Miller, 2015). Changes in gait as well as joint limitations commonly require referral for rehabilitation therapy. An individualized exercise program is crucial to improve movement. Table 57-4 summarizes the exercises appropriate for patients with rheumatic diseases. Physical and occupational therapy programs and interventions are beneficial in improving physical activity and maintaining range of motion. Such interventions may include stretching exercises, muscle conditioning, aerobic exercise, massage, acupuncture, chiropractic and osteopathic manipulation. Other strategies for decreasing pain include muscle relaxation techniques, imagery, self-hypnosis, and distraction. The use of transcutaneous electrical nerve stimulation (TENS) unit has also been found to improve pain and enhance physical activity (Carter et al., 2015). A mild analgesic agent may be suggested before exercise to improve pain during exercise. A weight reduction program may be recommended to relieve stress on painful joints for some patients. Any patient who experiences acute or prolonged pain associated with exercise should report the symptoms to their primary provider for evaluation.

TABLE 57-4 Exercise to Promote Mobility

Type of Exercise	Purpose	Recommended Performance	Precautions
Range of motion	Maintain flexibility and joint motion	Active or active/self-assisted at least daily	Reduce the number of repetitions when inflammation is present
Isometric exercise	Improve muscle tone, static endurance, and strength; prepare for dynamic and weight-bearing exercises	Perform at 70% of maximal voluntary contraction daily	Monitor blood pressure; isometric exercises may increase blood pressure and decrease blood flow to muscles
Dynamic exercise	Maintain or increase dynamic strength and endurance; increase muscle power; enhance synovial blood flow; promote strength of bone and cartilage	Start with repetitions against gravity and add progressive resistance; perform 2–3 days per week	May increase biomechanical stress on unstable or misaligned joints
Aerobic exercise	Improve cardiovascular fitness and endurance	Perform 3–5 days per week for 20–30 minutes of moderate-intensity exercise	Progress slowly as activity tolerance and fitness improve
Pool exercise	Water supports or resists movement; warm water may provide muscle relaxation	Provide buoyant medium for performance of dynamic or aerobic exercise	Heated swimming pool; deep water to minimize joint compression; nonslip footwear for safety and comfort. Receive appropriate instruction in a program designed for people with arthritis

Adapted from Carter S. C., Patty-Resk, C., Ruffing, V., et al. (2015). Core curriculum for rheumatology nursing (1st ed.). Greenville, SC: Lyons Den Solutions, LLC.

The major challenge for the patient and the health care provider is the need to adjust all aspects of treatment according to the activity of the disease. Especially for the patient with an active diffuse connective tissue disease, such as rheumatoid arthritis (RA) or systemic lupus erythematosus (SLE), activity levels may vary from day to day and even within a single day.

Sleep

Short-term use of low-dose antidepressant medications, such as amitriptyline (Elavil), may be prescribed to reestablish adequate sleep patterns and improve pain management (Papadakis, McPhee, & Rabow, 2015). Patients need restful sleep so that they can cope with pain, minimize physical fatigue, and deal with the changes related to having a chronic disease. In patients with acute disease, sleep time is frequently reduced and fragmented by prolonged awakenings. Stiffness, depression, and medications may also compromise the quality of sleep and increase daytime fatigue. A sleep-inducing routine, medication, and comfort measures may help improve the quality of sleep.

Education about sleep hygiene strategies may help promote restorative sleep. These strategies include establishing a set time to sleep and a regular wake-up time, creating a quiet sleep environment with a comfortable room temperature, avoiding factors that interfere with sleep (e.g., the use of alcohol and caffeine), using relaxation exercises, and getting out of bed and engaging in another activity (e.g., reading) if unable to sleep.

Nursing Management

Chart 57-2 details the nursing diagnoses, interventions, and expected outcomes for the patient with a rheumatic disorder.

Gerontologic Considerations

The various rheumatologic disease conditions in the older adult pose unique challenges. These challenges relate to disability, cognitive changes, comorbid conditions, and diagnosis. Musculoskeletal problems are the most frequently reported conditions in older adults (Miller, 2015) and will be seen more frequently by health professionals in the coming years along with associated disability, especially among frail older adults.

Comorbid conditions pose a unique challenge in diagnosing rheumatologic disease in older adults because they have the potential to mask or alter presenting symptoms (Papadakis et al., 2015). The frequency, pattern of onset, clinical features, severity, and effects on function of the rheumatic disease in older patients may be different in very old patients. In addition, other medical conditions may take precedence over the rheumatic disease, which commonly becomes a secondary diagnosis and concern. Decreased vision and altered balance, often present in older adults, may be problematic if rheumatic disease in the lower extremities affects locomotion. The combination of decreased hearing and visual acuity, memory loss, and depression contributes to failure to follow the treatment regimen in older adult patients as well (Miller, 2015). Special techniques for promoting patient safety, self-management, and strategies such as memory aids for medications may be necessary.

Behavioral clues such as gait patterns, guarding, and joint flexion may aid the nurse in assessing the patient's pain when cognitive impairment is present. Older adults, especially men, may also neglect to communicate their pain unless elicited by the provider. Pain, in general, in this population that is not treated or undertreated may impact the quality of life for these patients, which can exacerbate all other medical conditions (Carter et al., 2015).

Older adults have an increased risk of osteoporosis. Pain, loss of mobility, diminished self-image, and increasing morbidity can result from progressive osteoporosis. Therefore, diagnosis and treatment of osteoporosis should not be overlooked in this population. Pharmacologic therapy (including analgesic agents), exercise, postural assistance, modification of activities of daily living, and psychological support are useful components of the treatment program for the older adult.

Identifying the effects of the rheumatic disease on the patient's lifestyle, independence, and psychological status is important and can improve the quality of life for older adults. Depressed mood is routinely found in those suffering from chronic joint disease. The body image and self-esteem of the older adult with rheumatic disease, combined with underlying depression, may interfere with the use of assistive devices such as canes. The use of adaptive equipment such as long-handled reachers or tongs may be viewed by the older adult as evidence of aging rather than as a means of increasing independence.

Because most rheumatologic diseases involve pain, especially with joints, some older adults may consider their symptoms as inevitable consequences of aging. In fact, many older adults expect and accept the immobility and self-care problems related to the rheumatic diseases and do not seek help, thinking that nothing can be done.

The older adult usually has a lifelong pattern of dealing with the stresses of daily life. Depending on the success of that pattern, the older adult can often maintain a positive attitude and self-esteem when faced with a rheumatic disease, especially if support is available. Previous stress management strategies are assessed. If these strategies have been effective, the patient is encouraged and supported in their use. If they were ineffective, the nurse assists the patient in identifying alternative strategies, encourages the use of new strategies, and assesses their effectiveness.

Pharmacologic treatment of rheumatic disease in older patients is more difficult than in younger patients. If therapeutic medications have an effect on the senses (hearing, cognition), this effect is intensified in the older adult. The cumulative effect of medications, in general, is accentuated because of the physiologic changes of aging. For example, decreased renal function in the older adult alters the metabolism of certain medications, such as NSAIDs. Older adults are more prone to side effects associated with the use of multiple-drug therapy.

Partly because of the more frequent contact of older adults with health care providers for a variety of health issues, overtreatment or inappropriate treatment is possible. Complaints of pain may be met with a prescription for an opioid analgesic agent rather than instructions for rest, the use of an assistive device, and local comfort measures such as heat or cold. Acetaminophen/paracetamol (Tylenol) may be appropriate and worth trying before other medications that pose a greater chance of side effects. NSAIDs can be used; however, studies report that long-term use of NSAIDs can increase the risks of peptic ulcers, hemorrhage and cardiovascular toxicity. New guidelines recommend NSAIDs should be used in conjunction with a proton pump inhibitor (i.e., omeprazole [Prilosec]) to decrease the likelihood of gastric ulcers forming, hemorrhage and cardiovascular toxicity (Fujita, Kutsumi, Sanuki, et al., 2013).

Intra-articular corticosteroid injections, with their usually rapid relief of symptoms, may be requested by the patient who is unaware of the consequences of too-frequent use of this

Chart 57-2 PLAN OF NURSING CARE

Care of the Patient with a Rheumatic Disorder

Nursing Diagnosis: Acute and chronic pain related to inflammation and increased disease activity, tissue damage, fatigue, or lowered tolerance level
Goal: Improvement in comfort level; incorporation of pain management techniques into daily life

Nursing Interventions	Rationale	Expected Outcomes
1. Provide variety of comfort measures: a. Application of heat or cold b. Massage, position changes, rest c. Foam mattress, supportive pillow, splints d. Relaxation techniques, diversional activities	1. Pain may respond to nonpharmacologic interventions, such as exercise, relaxation, and thermal modalities.	• Identifies factors that exacerbate or influence pain response • Identifies and uses pain management strategies • Verbalizes decrease in pain • Reports signs and symptoms of side effects in timely manner to prevent additional problems • Verbalizes that pain is characteristic of rheumatic disease • Establishes realistic pain relief goals • Identifies changes in quality or intensity of pain
2. Administer anti-inflammatory, analgesic, and slow-acting antirheumatic medications as prescribed.	2. Pain of rheumatic disease responds to individual or combination medication regimens.	
3. Individualize medication schedule to meet patient's need for pain management.	3. Previous pain experiences and management strategies may be different from those needed for persistent pain.	
4. Encourage verbalization of feelings about pain and chronicity of disease.	4. Verbalization promotes coping.	
5. Assess for subjective changes in pain.	5. The impact of pain on an individual's life often leads to misconceptions about pain and pain management techniques. 6. The individual's description of pain is a more reliable indicator than objective measurements such as change in vital signs, body movement, and facial expression.	

Nursing Diagnosis: Fatigue related to increased disease activity, pain, inadequate sleep/rest, deconditioning, inadequate nutrition, and emotional stress/depression
Goal: Incorporates as part of daily activities strategies necessary to modify fatigue

Nursing Interventions	Rationale	Expected Outcomes
1. Provide instruction about fatigue. a. Describe relationship of disease activity to fatigue. b. Describe comfort measures while providing them. c. Develop and encourage a sleep routine (warm bath and relaxation techniques that promote sleep). d. Explain importance of rest for relieving systematic, articular, and emotional stress. e. Explain how to use energy conservation techniques (pacing, delegating, setting priorities). f. Identify physical and emotional factors that can cause fatigue.	1. The patient's understanding of fatigue will affect their actions. a. The amount of fatigue is directly related to the activity of the disease. b. Relief of discomfort can relieve fatigue. c. Effective bedtime routine promotes restorative sleep. d. Different kinds of rest are needed to relieve fatigue and are based on patient's need and response. e. A variety of measures can be used to conserve energy. f. Awareness of the various causes of fatigue provides the basis for measures to modify the fatigue.	• Self-evaluates and monitors fatigue pattern • Verbalizes the relationship of fatigue to disease activity • Uses comfort measures as appropriate • Practices effective sleep hygiene and routine • Makes use of various assistive devices (splints, canes) and strategies (bed rest, relaxation techniques) to ease different kinds of fatigue • Incorporates time management strategies in daily activities • Uses appropriate measures to prevent physical and emotional fatigue • Has an established plan to ensure well-paced, therapeutic activity schedule • Adheres to therapeutic program • Follows a planned conditioning program • Consumes a nutritious diet consisting of the five major groups and recommended daily allowance of vitamins and minerals
2. Facilitate development of appropriate activity/rest schedule.	2. Alternating rest and activity conserves energy while allowing most productivity.	
3. Encourage adherence to the treatment program.	3. Overall control of disease activity can decrease the amount of fatigue.	
4. Refer to and encourage a conditioning program.	4. Deconditioning resulting from lack of mobility, understanding, and disease activity contributes to fatigue.	
5. Encourage adequate nutrition, including source of iron from food and supplements.	5. A nutritious diet can help counteract fatigue.	

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Nursing Diagnosis: Impaired physical mobility related to decreased range of motion, muscle weakness, pain on movement, limited endurance, lack of or improper use of ambulatory devices
Goal: Attains and maintains optimal functional mobility

Nursing Interventions	Rationale	Expected Outcomes
1. Encourage verbalization regarding limitations in mobility.	1. Mobility is not necessarily related to deformity. Pain, stiffness, and fatigue may temporarily limit mobility. The degree of mobility is not synonymous with the degree of independence. Decreased mobility may influence a person's self-concept and lead to social isolation.	• Identifies factors that interfere with mobility • Describes and uses measures to prevent loss of motion • Identifies environmental (home, school, work, community) barriers to optimal mobility • Uses appropriate techniques, assistive equipment, or both to aid mobility • Identifies community resources available to assist in managing decreased mobility
2. Assess need for occupational or physical therapy consultation. a. Emphasize range of motion of affected joints. b. Promote the use of assistive ambulatory devices. c. Explain the use of safe footwear. d. Use individual appropriate positioning/posture.	2. Therapeutic exercises, proper footwear, and/or assistive equipment may improve mobility. Correct posture and positioning are necessary for maintaining optimal mobility.	
3. Assist to identify environmental barriers.	3. Furniture and architectural adaptations may enhance mobility.	
4. Encourage independence in mobility and assist as needed. a. Allow ample time for activity. b. Provide rest period after activity. c. Reinforce principles of pacing and work simplification.	4. Changes in mobility may lead to a decrease in personal safety.	
5. Initiate referral to community health agency.	5. The degree of mobility may be slow to improve or may not improve with intervention.	

Nursing Diagnosis: Readiness for enhanced self-care related to contractures, fatigue, or loss of motion
Goal: Performs self-care activities independently or with the use of resources

Nursing Interventions	Rationale	Expected Outcomes
1. Assist patient to identify self-care deficits and factors that interfere with ability to perform self-care activities.	1. The ability to perform self-care activities is influenced by the disease activity and the accompanying pain, stiffness, fatigue, muscle weakness, loss of motion, and depression.	• Identifies factors that interfere with the ability to perform self-care activities • Identifies alternative methods for meeting self-care needs • Uses alternative methods for meeting self-care needs • Identifies and uses other health care resources for meeting self-care needs
2. Develop a plan based on the patient's perceptions and priorities on how to establish and achieve goals to meet self-care needs, incorporating energy conservation, and work simplification concepts. a. Provide appropriate assistive devices. b. Reinforce correct and safe use of assistive devices. c. Allow patient to control timing of self-care activities. d. Explore with the patient different ways to perform difficult tasks or ways to enlist the help of someone else.	2. Assistive devices may enhance self-care abilities. Effective planning for changes must include the patient, who must accept and adopt the plan.	
3. Consult with community health care agencies when individuals have attained a maximum level of self-care yet still have some deficits, especially regarding safety.	3. Individuals differ in ability and willingness to perform self-care activities. Changes in ability to care for self may lead to a decrease in personal safety.	

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Nursing Diagnosis: Disturbed body image related to physical and psychological changes and dependency imposed by chronic illness
Goal: Adapts to physical and psychological changes imposed by the rheumatic disease

Nursing Interventions	Rationale	Expected Outcomes
1. Help patient identify elements of control over disease symptoms and treatment.	1. The individual's self-concept may be altered by the disease or its treatment.	• Verbalizes an awareness that changes taking place in self-concept are normal responses to rheumatic disease and other chronic illnesses
2. Encourage patient's verbalization of feelings, perceptions, and fears. a. Help to assess present situation and identify problems.	2. The individual's coping strategies reflect the strength of their self-concept.	• Identifies strategies to cope with altered self-concept

Nursing Diagnosis: Ineffective coping related to actual or perceived lifestyle or role changes
Goal: Use of effective coping behaviors for dealing with actual or perceived limitations and role changes

Nursing Interventions	Rationale	Expected Outcomes
1. Identify areas of life affected by disease. Answer questions and dispel possible myths. a. Assist to identify past coping mechanisms. b. Assist to identify effective coping mechanisms.	1. The effects of disease may be more or less manageable once identified and explored reasonably.	• Names functions and roles affected and not affected by disease process • Describes therapeutic regimen and states actions to take to improve, change, or accept a particular situation, function, or role
2. Develop plan for managing symptoms and enlisting support of family and friends to promote daily function.	2. By taking action and involving others appropriately, patient develops or draws on coping skills and community support.	

Collaborative Problems: Complications secondary to effects of medications
Goal: Absence or resolution of complications

Nursing Interventions	Rationale	Expected Outcomes
1. Perform periodic clinical assessment and laboratory evaluation.	1. Skillful assessment helps detect early symptoms of side effects of medications.	• Adheres to monitoring procedures and experiences minimal side effects • Takes medication as prescribed and lists potential side effects • Identifies strategies to reduce or manage side effects • Reports that side effects or complications have subsided
2. Provide education about correct self-administration, potential side effects, and importance of monitoring.	2. The patient needs accurate information about medications and potential side effects to avoid or manage them.	
3. Counsel regarding methods to reduce side effects and manage symptoms.	3. Appropriate identification and early intervention may minimize complications.	
4. Administer medications in modified doses as prescribed if complications occur.	4. Modifications may help minimize side effects or other complications.	

treatment. In addition, exercise programs may not be instituted or may be ineffective because the patient expects results to occur quickly or fails to appreciate the effectiveness of a program of exercise. In fact, strength training is encouraged in the older adult with chronic diseases.

Diffuse Connective Tissue Diseases

Diffuse connective tissue disease refers to a group of systemic disorders that are chronic in nature and are characterized by diffuse inflammation and degeneration in the connective tissues. These disorders share similar clinical features and may affect some of the same organs. The characteristic clinical course is one of exacerbations and remissions. Although diffuse connective tissue diseases have unknown causes, they are thought to be the result of immunologic abnormalities. They include RA, SLE, scleroderma, polymyositis, Sjögren's syndrome, polymyalgia rheumatica (PMR), and giant cell arteritis (GCA).

Rheumatoid Arthritis

RA is an autoimmune disease of unknown origin that affects 1% of the population worldwide, with females having a 2.5 times greater incidence than males. It may occur at any age but the onset commonly occurs between the third and sixth decade of life. The incidence of RA increases after the sixth decade of life (Carter et al., 2015). Risk factors for the development of RA include environmental factors such as pollution and smoking, family history of first-degree relatives, and illnesses such as bacterial and viral illnesses. Cigarette smoking is one modifiable risk factor that has been shown to be highly related to RA (Carter et al., 2015).

Pathophysiology

The exact mechanism of action for the etiology of RA is unknown. Research has, however, identified that the autoimmune reaction (see Fig. 57-1) originates in the synovial tissue. It is hypothesized that both environmental factors, such as cigarette smoking, and genetic factors coalesce to produce inflammatory and destructive synovial fluid, starting in the more distal joints. This RA synovium breaks down collagen, causing edema, proliferation of the synovial membrane, and ultimately pannus formation. Pannus destroys cartilage and erodes the bone. The consequence is the loss of articular surfaces and joint motion. Muscle fibers undergo degenerative changes. Tendon and ligament elasticity and contractile power are lost.

The RA inflammatory process has also been implicated in other disease processes (i.e., arteriosclerosis). It is hypothesized that the RA disease process somehow interferes with the production of high-density lipoprotein cholesterol, which is the form of cholesterol responsible for decreasing cellular lipids and, therefore, is considered antiatherosclerotic.

The nervous system is also affected by the RA inflammatory process. The synovial inflammation can compress the adjacent nerve, causing neuropathies and paresthesias. Axonal degeneration and neuronal demyelination are also possible due to the infiltration of polymorphonuclear leukocytes, eosinophils, and mononuclear cells, causing necrotizing or occlusive vasculitis (Ramos-Remus, Duran-Barragan, & Castillo-Ortiz, 2012).

Clinical Manifestations

The American College of Rheumatology and the European League Against Rheumatism have collaborated and established new criteria for classifying RA. These criteria are based on a point system where a total score of 6 or greater is required for the diagnosis of RA. The scoring system is based on joint involvement (number of joints affected), serology (low positive or high positive rheumatoid factor [RF] or anti-citrullinated peptide antibody [ACPA]), abnormal results of the acute phase reactants (erythrocyte sedimentation rate [ESR] or C- reactive protein [CRP]), and duration of symptoms greater than 6 weeks. Patients diagnosed with RA who are excluded from these diagnostic criteria include: (1) patients who have one joint with synovitis that is not related to any other clinical disease and who also score at least 6 to 10 points on the scale, and (2) patients diagnosed with bony erosions on X-ray (Aletaha, Neogi, Silman, et al. 2010).

The initial clinical manifestations of RA include symmetric joint pain and morning joint stiffness lasting longer than 1 hour. Over the course of the disease, clinical manifestations of RA vary, usually reflecting the stage and severity of the disease. Symmetric joint pain, swelling, warmth, erythema, and lack of function are classic symptoms. Palpation of the joints reveals spongy or boggy tissue. Often, fluid can be aspirated from the inflamed joint. Characteristically, the pattern of joint involvement begins in the small joints of the hands, wrists, and feet (Klippel, Stone, Crofford, et al., 2008); (Papadakis et al., 2015). As the disease progresses, the knees, shoulders, hips, elbows, ankles, cervical spine, and temporomandibular joints are affected. The onset of symptoms is usually acute. Symptoms are usually bilateral and symmetric.

In the early stages of disease, even before the presentation of bony changes, limitation in function can occur when there is active inflammation in the joints. Joints that are hot, swollen, and painful are not easily moved. The patient tends to guard or protect these joints by immobilizing them. Immobilization for extended periods can lead to contractures, creating soft tissue deformity.

Deformities of the hands (e.g., ulnar deviation and swan neck deformity) and feet are common in RA (see Fig. 35-6 in Chapter 35). The deformity may be caused by misalignment resulting from swelling, progressive joint destruction, or the subluxation (partial dislocation) that occurs when one bone slips over another and eliminates the joint space. Deformities of RA differ from those seen with osteoarthritis (OA), such as Heberden's and Bouchard's nodes.

RA is a systemic disease with multiple extra-articular features. Most common are fever, weight loss, fatigue, anemia, lymph node enlargement, and Raynaud's phenomenon (cold- and stress-induced vasospasm causing episodes of digital blanching or cyanosis). Rheumatoid nodules may be noted in patients with more advanced RA, and they develop at some time in the course of the disease in about 20% of patients (Papadakis et al., 2015). These nodules are usually nontender and movable in the subcutaneous tissue. They usually appear over bony prominences such as the elbow, are varied in size, and can disappear spontaneously. Nodules occur only in people who have rheumatoid factor. The nodules often are associated with rapidly progressive and destructive disease. Other extra-articular features include arteritis, neuropathy, pericarditis, splenomegaly, and Sjögren's syndrome (dry eyes and dry mucous membranes).

Assessment and Diagnostic Findings

Several assessment findings are associated with RA: rheumatoid nodules, joint inflammation detected on palpation, and laboratory findings. The history and physical examination focus on manifestations, such as bilateral and symmetric stiffness, tenderness, swelling, and temperature changes in the joints. The patient is also assessed for extra-articular changes; these often include weight loss, sensory changes, lymph node enlargement, and fatigue. Symptoms and examination findings are often recorded using a Disease Activity Score-28 (DAS28) form to evaluate disease activity and help guide treatment decisions.

RA inflammatory processes have also been implicated in arterial wall stiffness and endothelial dysfunction. It is now believed that cardiovascular risks are similar to the risks of patients with diabetes. Therefore, cardiovascular risk assessment should be included in the patient's physical assessment (Palmer & El Miedany, 2014).

Rheumatoid factor is present in about 70% to 80% of patients with RA, but its presence alone is not diagnostic of RA, and its absence does not rule out the diagnosis. Antibodies to cyclic citrullinated peptide (anti-CCP) have a specificity of approximately 95% at detecting RA (Papadakis et al., 2015). The ESR and CRP tend to be significantly elevated in the acute phases of RA and are therefore useful in monitoring active disease and disease progression. The complete blood count (CBC) should be assessed to establish a baseline count especially prior to starting medications. Patients may exhibit anemia, and platelets may be elevated due to the inflammatory process. A tuberculin (TB) skin test should be done prior to the initiation of certain medications to rule out tuberculosis. In the event the patient has latent TB and has never been treated, the infection can be reactivated. Hepatitis B and Hepatitis C should also be assessed for diagnosis, which could impact treatment strategies if positive. If the client tests positive for hepatitis, the infection should be treated prior to starting medication. Liver and kidney monitoring is recommended for most DMARD therapy because it can cause elevation of the liver enzymes and can also affect kidney function.

X-ray, ultrasound, or both of the hands, wrists, and feet can be useful in establishing a baseline for joint evaluation, and assessing the joints for erosions and synovitis. Joint damage may occur within the first 6 to 12 months of diagnosis and should be followed as indicated. MRI can also be useful to detect small erosions that may not be visible on x-ray or ultrasound.

Arthrocentesis may also be performed on any affected joint. Results of the arthrocentesis may show synovial fluid that is cloudy, milky, or dark yellow and may contain numerous inflammatory components. Recommended tests to perform on synovial fluid include WBC with differential, cultures, gram stain and crystals (Sholter & Russell, 2016).

Medical Management

The goal of treatment at all phases of the RA disease process is to decrease joint pain and swelling, achieve clinical remission, decrease the likelihood of joint deformity, and minimize disability. Initial treatment delays have been implicated in greater long-term joint deformity. Aggressive and early treatment regimens are warranted.

Early Rheumatoid Arthritis

Once the diagnosis of RA is made, treatment should begin with either a nonbiologic or biologic DMARD. The goal of using DMARD therapy is preventing inflammation and joint damage. Recommended treatment guidelines include beginning with the nonbiologic DMARDs (methotrexate [Rheumatrex], leflunomide [Arava], sulfasalazine [Azulfidine]), or hydroxychloroquine (Plaquenil) within 3 months of disease onset. Care should be used with each of these medications, by performing routine blood testing for liver and kidney function, along with monitoring the CBC for anemia. Dosage may need to be modified for patients with renal impairment. Annual eye examinations are also recommended with the use of sulfasalazine and hydroxychloroquine (Carter et al., 2015).

After initiating treatment with a DMARD, patients generally report a beneficial effect within 6 weeks and tolerate the medication relatively well (Papadakis et al., 2015). However, some patients may take longer to see improvement. Research suggests that methotrexate combined with low-dose prednisone improves patient outcome compared to the use of methotrexate alone for early RA.

Another treatment approach for RA is the use of biologic DMARDs. These agents have been specifically engineered to target the most prominent proinflammatory mediators in RA—TNF-α, B cells, T cells, IL-1, and IL-6 (Klippel et al., 2008) (see Table 57-3). Biologic DMARDs are the first targeted therapy for RA. Clinical evidence suggests that biologic DMARDs work more quickly and show a greater delay in radiologic disease progression when compared to nonbiologic DMARDs (Klippel et al., 2008). The biologic DMARDs are more expensive and have fewer years of usage with the RA population. Therefore, they tend to be reserved for patients with persistent moderate-to-severe RA who have not responded adequately to synthetic DMARDs (Papadakis et al., 2015).

NSAIDs and specifically the cyclooxygenase 2 (COX2) enzyme blockers are used for pain and inflammation relief. NSAIDs, such as ibuprofen (Motrin) and naproxen (Naprosyn), are commonly prescribed because of their low cost and analgesic properties. They must be used, however, with caution in long-term chronic diseases because of the possibility of gastric ulcers. Several COX-2 enzyme blockers have been approved for treatment of RA. Cyclo-oxygenase is an enzyme that is involved in the inflammatory process. COX-2 medications block the enzyme involved in inflammation (COX-2) while leaving intact the enzyme involved in protecting the stomach lining (COX-1). As a result, COX-2 enzyme blockers are less likely to cause gastric irritation and ulceration than other NSAIDs; however, they are associated with increased risk of cardiovascular disease and must be used with caution (Karch, 2014). The nurse should be aware that no NSAIDs, not even the COX-2 inhibitors, prevent erosions or alter disease progression and, consequently, are medications useful only for symptom relief.

Additional analgesia may be prescribed for periods of extreme pain. Opioid analgesic agents are avoided because of the potential for continuing need for pain relief. Nonpharmacologic pain management techniques (e.g., relaxation techniques, heat and cold applications) are taught (Carter et al., 2015).

Moderate, Erosive Rheumatoid Arthritis

For moderate, erosive RA, a formal program with occupational and physical therapy is prescribed to educate the patient about principles of pacing activities, work simplification, range of motion, and muscle-strengthening exercises. The patient is encouraged to participate actively in the management program. The medication program is reevaluated periodically, and appropriate changes are made if indicated. Cyclosporine, an immunosuppressant, may be added to enhance the disease-modifying effect of methotrexate (Klippel et al., 2008). Combination therapy using one nonbiologic DMARD and one biologic DMARD is common.

Persistent, Erosive Rheumatoid Arthritis

For persistent, erosive RA, reconstructive surgery and corticosteroids are often used. Reconstructive surgery is indicated when pain cannot be relieved by conservative measures and the threat of loss of independence is eminent. Surgical procedures include synovectomy (excision of the synovial membrane), tenorrhaphy (suturing of a tendon), arthrodesis (surgical fusion of the joint), surgical repair, and replacement of the joint. Surgery is not performed during exacerbations.

Systemic corticosteroids are used when the patient has unremitting inflammation and pain or needs a "bridging" medication while waiting for the slower DMARDs (e.g., methotrexate) to begin taking effect. Low-dose corticosteroid therapy is prescribed for the shortest time necessary to minimize side effects (Papadakis et al., 2015). Single large joints that are severely inflamed and fail to respond promptly to the measures outlined previously may be treated by local injection of a corticosteroid.

Advanced, Unremitting Rheumatoid Arthritis

For advanced, unremitting RA, immunosuppressive agents are prescribed because of their ability to affect the production of antibodies at the cellular level. These include high-dose methotrexate, cyclophosphamide (Cytoxan), and azathioprine (Imuran). However, these medications are highly toxic and can produce bone marrow suppression, anemia, gastrointestinal disturbances, severe birth defects, and rashes (Karch, 2014).

For most patients with RA, the emotional and possible financial burden of the disease can lead to depressive symptoms and sleep deprivation. The patient may require the short-term use of low-dose antidepressant medications, such as amitriptyline (Elavil), paroxetine (Paxil), or sertraline (Zoloft), to reestablish an adequate sleep pattern and manage depressive

symptoms. Patients may benefit from referrals for talk therapy or group support.

Nutrition Therapy

Patients with RA frequently experience anorexia, weight loss, and anemia. A dietary history identifies usual eating habits and food preferences. Two common problems seen in these patients are weight loss and rheumatoid cachexia (loss of skeletal muscle). Increased metabolism and decreased intake contribute to these losses. Increased and prolonged flares contribute to the increased expenditure as well. The dietician will counsel the patient about better food choices. Food selection should include the five major groups (grains, vegetables, fruits, dairy, and protein), with emphasis on foods high in vitamins, protein, and iron for tissue building and repair. For the patient who is extremely anorexic, small, frequent feedings with increased protein supplements may be prescribed. Supplemental vitamins and minerals may also be prescribed as needed. Boswellia, ginger, green tea, and turmeric have been studied for helping with inflammation and pain. However, the American College of Rheumatology does not recommend herbal supplements to treat RA as the U.S. Food and Drug Administration (FDA) does not regulate the safety and effectiveness of herbal supplements (Afshar, 2015).

Certain medications (i.e., oral corticosteroids) used in RA treatment stimulate the appetite and, when combined with decreased activity, may lead to weight gain. Therefore, patients may need to be counseled about eating a healthy, calorie-restricted diet.

Nursing Management

Nursing care of the patient with RA follows the basic plan of care presented earlier (see Chart 57-2). The most common issues for the patient with RA include pain, sleep disturbance, fatigue, altered mood, and limited mobility. The patient with newly diagnosed RA needs information about the disease to make daily self-management decisions and cope with having a chronic disease. Consultation with a dietician for assessment and assistance with appropriate food choices may be helpful.

Monitoring and Managing Potential Complications

Patients commonly have comorbid conditions such as cardiovascular disease that can lead to complications. It has been estimated that the primary cause of death for up to 40% of patients diagnosed with RA is cardiovascular disease. The cause of cardiovascular disease in these patients is thought to be due to elevated lipid values, chronic inflammation, dysfunction of the endothelium, and/or abnormal homocysteine levels (Palmer & El Miedany, 2014).

Medications used for treating RA may cause serious adverse effects. The primary provider bases the prescribed medication regimen on clinical findings and past medical history, and then, with the help of the nurse, monitors for side effects using periodic clinical assessments and laboratory testing. The nurse, who can be available for consultation between visits with the primary provider, works to help the patient recognize and deal with these side effects (see Table 57-3). Medication may need to be stopped or the dose reduced. If the patient experiences an increase in symptoms while the complication is being resolved or a new medication is being initiated, the nurse's counseling regarding symptom management may relieve potential anxiety and distress.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

Patient education is an essential aspect in nursing care of the patient with RA to enable the patient to maintain as much independence as possible, to take medications accurately and safely, and to use adaptive devices correctly (Cottrell, Jonas, Bergsten, et al., 2013). Patient education focuses on the disorder itself, the possible changes related to the disorder, the therapeutic regimen prescribed to treat it, and the potential side effects of medications (see Nursing Research Profile in Chart 57-3). Patients undergoing surgery need education as well. The nurse works with the patient and family on strategies to maintain independence, function, and safety in the home (see Chart 57-4).

The patient and family are encouraged to verbalize their concerns and ask questions. Because RA commonly affects young women, major concerns may be related to the effects of the disease on childbearing potential, caring for family, or work responsibilities. The patient with a chronic illness may seek a "cure" or have questions about alternative therapies. There is not enough evidence of the effectiveness of complementary, alternative, and integrative health therapies, and more rigorous research is needed (Marcus, 2015).

Chart 57-3 NURSING RESEARCH PROFILE

Addressing Unmet Needs of Patients with Rheumatoid Arthritis

Cottrell, J. D., Jonas, M., Bergsten, U., et al. (2013). The nurse's role in addressing unmet treatment and management needs of patients with rheumatoid arthritis: Delphi-based recommendations. International Journal of Nursing Knowledge, 24(2), 66–76.

Purpose

Nurses spend a lot of time with patients with rheumatoid arthritis (RA). The purpose of this research was to evaluate the nurse's role in management of patients with RA.

Design

The modified Delphi methodology was the design for this study. Three rheumatology nurses developed a survey questionnaire. An additional group of 12 international rheumatology nurses, with extensive patient management experience, served as an expert panel. The survey was given to the panel of 12 rheumatology nurses in two online rounds and then in a third round during an in-person meeting.

Findings

The nurse has many roles in the management of patients with RA. In this study, the nurse's reported roles involved providing care, educating about treatment, performing a disease assessment, giving the patient treatment feedback, helping patients with unmet physical and emotional needs, and explaining complex treatments.

Nursing Implications

Rheumatology nurses are in a position to be able to expand the nursing role for patients diagnosed with RA. These nurses already perform the roles of caregiver and educator, and provide disease assessment. It is important for nurses to also address unmet patient needs, provide improved patient care, and perform additional functions for the patients to meet unmet physical and emotional needs.

Chart 57-4 HOME CARE CHECKLIST

The Patient with Rheumatoid Arthritis

At the completion of education, the patient, caregiver, or both will be able to:

- State the impact of rheumatoid arthritis on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State changes in lifestyle (e.g., diet, activity, rest) necessary to maintain health.
- State the name, dose, side effects, frequency, and schedule for all medications.
- Demonstrate accurate and safe self-administration of medications.
- Describe and demonstrate the use of pain management techniques.
- Demonstrate ability to perform ADLs independently or with assistive devices/adaptive equipment.
- Verbalize ways to cope with stress successfully, plans for regular, safe exercise, and rationale for obtaining adequate rest.
- Demonstrate a relaxation technique.
- Verbalize a dietary plan that includes increased vitamins, protein, and iron for tissue building and repair
- State how to reach primary provider with questions or complications
- State time and date of follow-up appointments, testing
- Identify the need for health promotion, disease prevention, and screening activities
- Identify community resources for peer and caregiver/family information and support:
- Identify sources of support (e.g., friends, relatives, faith community)
- Identify phone numbers of support groups for people with chronic illness/disabilities and their caregivers/families
- State meeting locations and times

ADLs, activities of daily living; IADLs, independent activities of daily living.

Pain, fatigue, and depressive symptoms can interfere with the patient's ability to learn and should be addressed before the instruction is initiated. Various educational strategies may then be used, depending on the patient's previous knowledge base, interest level, degree of comfort, social or cultural influences, and readiness to learn. The nurse educates the patient about basic disease management and necessary adaptations in lifestyle. Some types of aerobic exercise and strength training should be discussed. Because suppression of inflammation and autoimmune responses requires the use of anti-inflammatory, disease-modifying antirheumatic, and immunosuppressive agents, the patient is taught about prescribed medications, including type, dosage, rationale, potential side effects, self-administration, and required monitoring procedures. If hospitalized, the patient is encouraged to practice new self-management skills with support from caregivers and significant others. The nurse then reinforces disease management skills during each patient contact. Barriers are assessed, and measures are taken to promote adherence to medications and the treatment program.

Continuing and Transitional Care

Depending on the severity of the disease and the patient's resources and supports, referral for home care may be warranted. For example, the patient who is an older adult or frail, has RA that limits function significantly, and lives alone may need referral for home care.

The impact of RA on everyday life is not always evident when the patient is seen in the hospital or in an ambulatory care setting. The increased frequency with which nurses see patients in the home provides opportunities for recognizing problems and implementing interventions aimed at improving the quality of life of patients with RA.

During home visits, the nurse has the opportunity to assess the home environment and its adequacy for patient safety and management of the disorder. Adherence to the treatment program can be more easily monitored in the home setting, where physical and social barriers to adherence are more readily identified. For example, a patient who also has diabetes and requires insulin may be unable to fill the syringe accurately or unable to administer the insulin because of impaired joint mobility. Appropriate adaptive equipment needed for increased independence is often identified more readily when the nurse sees how the patient functions in the home. Any barriers to adherence are identified, and appropriate referrals are made.

For patients at risk for impaired skin integrity, the home care nurse can closely monitor skin status and also educate, provide, or supervise the patient and family in preventive skin care measures. The nurse also assesses the patient's need for assistance in the home and supervises home health aides, who may meet many of the needs of the patient with RA. Referrals to physical and occupational therapists may be made as problems are identified and limitations increase. A home care nurse may visit the home to make sure that the patient can function as independently as possible despite mobility problems and can safely manage treatments, including pharmacotherapy.

Because many of the medications used to suppress inflammation are injectable, the nurse may administer the medication to the patient or educate about self-injection. These frequent contacts allow the nurse to reinforce other disease management techniques.

The nurse also assesses the patient's physical and psychological status, adequacy of symptom management, and adherence to the management plan. Patients should know which type of rheumatic disease they have, not just that they have "arthritis" or "arthritis of the knee." The importance of attending follow-up appointments is emphasized to the patient and family, and they should be reminded about the importance of participating in other health promotion activities and health screening.

Systemic Lupus Erythematosus

SLE is an inflammatory, autoimmune disorder that affects nearly every organ in the body. The overall incidence of SLE is estimated to be 1.8 to 7.6 per 100,000 persons (Centers for Disease Control and Prevention [CDC], 2015a). It occurs 6 to10 times more frequently in women than in men and occurs 3 times more in African American populations than among Caucasians (CDC, 2015a); (Lim, Bayakly, Helmick, et al., 2014). In addition to SLE, many other forms of adult lupus exist, including discoid lupus erythematosus (which primarily affects the skin on the face), subacute cutaneous lupus erythematous (sun exposed areas affected with sores), and drug-induced lupus (rarely includes brain or kidney effects and is usually temporary).

Pathophysiology

SLE starts with the body's immune system inaccurately recognizing one or more components of the cell's nucleus as foreign, seeing it as an antigen. The immune system starts to develop antibodies to the nuclear antigen. In particular, B cells begin to overproduce antibodies with the help of multiple cytokines such as B-lymphocyte stimulator (BLyS), which is overexpressed in SLE. The antibodies and antigens form antigen–antibody complexes and have the propensity to get trapped in the capillaries of visceral structures. The antibodies also act to destroy host cells. It is thought that those two mechanisms are responsible for the majority of the clinical manifestations of this disease process. It is hypothesized that the immunoregulatory disturbance is brought about by some combination of four distinct factors: genetic, immunologic, hormonal, and environmental (Carter et al., 2015).

Research into the genetic origins of SLE has thus far revealed that multiple genes are likely implicated in the development of SLE. In support of this theory, research with homozygous twins has shown a higher incidence of SLE, especially considering that the prevalence of SLE was low in other family members (Bartels, 2015). The large majority of SLE cases, however, remain sporadic and unrelated to family medical history.

Given the acute number of women with SLE compared with men, it is hypothesized that female sex hormones (estrogen) play a role in the predisposition to SLE. Estrogen may contribute to the body's response of overreacting to the body's own tissues.

Although genetics and hormones likely play a role in the predisposition of SLE, it is hypothesized that an exogenous or environmental trigger is implicated in the onset of the disease process. These triggers may include cigarette smoke, ultraviolet rays exposure from sunlight and fluorescent light bulbs, medications (sulfa drugs, penicillin, or antibiotic drugs), viral, infections, emotional stress, stress on the body (e.g., surgery, pregnancy), and silica dust exposure in the occupational setting (Carter et al., 2015).

Clinical Manifestations

SLE is an autoimmune, systemic disease that can affect any body system. The disease process involves chronic states where symptoms are minimal or absent and acute flares where symptoms and lab results are elevated. Systemic symptoms include fever, malaise, weight loss, and anorexia. The mucocutaneous, musculoskeletal, renal, nervous, cardiovascular, and respiratory systems are most commonly involved. Less commonly affected are the gastrointestinal tract and liver as well as the ocular system.

Some type of cutaneous system manifestation is experienced in 80% to 90% of patients with SLE (Bartels, 2015); (Klippel et al., 2008). Four of the 11 criteria used for diagnosing SLE by the American College of Rheumatology involve the cutaneous system. The most familiar skin manifestation (occurring in less than 50% of patients with SLE) is an acute cutaneous lesion consisting of a butterfly-shaped erythematous rash across the bridge of the nose and cheeks (see Fig. 57-2). Several other skin manifestations may occur in patients with SLE, including subacute cutaneous lupus erythematosus, which involves papulosquamous or annular polycyclic lesions, and a discoid rash, which is a chronic rash with erythematous papules or plaques and scaling and can cause scarring and pigmentation changes. In some cases, the only skin involvement may be a discoid rash. In some patients with SLE, the initial skin involvement is the precursor to more systemic involvement. The lesions often worsen during **exacerbations** (flares) of the systemic disease and possibly are provoked by sunlight or artificial ultraviolet light (Bartels, 2015); (Klippel et al., 2008). Oral ulcers, which may accompany skin lesions, may involve the buccal mucosa or the hard palate, occur in crops, and are often associated with exacerbations. Other cutaneous manifestations include splinter hemorrhages, alopecia, and Raynaud's phenomenon.



Figure 57-2 • The characteristic butterfly rash of systemic lupus erythematosus.

Joint symptoms, with arthralgias, arthritis (synovitis), or both, occur in more than 90% of patients with SLE and are commonly the earliest manifestation of the disease process (Papadakis et al., 2015). Joint swelling, tenderness, and pain on movement are also common. Frequently, these are accompanied by morning stiffness.

The cardiac system is also commonly affected in SLE. Pericarditis is the most common cardiac manifestation (Bartels, 2015); (Klippel et al., 2008). Patients may present with substernal chest pain that is aggravated by movement or inspiration. Symptoms can be acute and severe or last for weeks at a time. Other cardiac symptoms may involve myocarditis, hypertension, cardiac dysrhythmias, and valvular incompetence. Women who have SLE are also at risk for early-onset atherosclerosis, making them much more likely to suffer myocardial infarction or stroke. These events, which are believed to be secondary to the accelerated atherosclerosis, may contribute to higher rates of death for women with SLE. Inflammation is believed to be the key factor in the development and progression of atherosclerosis (Bartels, 2015).

Nephritis as a result of SLE, also referred to as lupus nephritis, occurs due to a buildup of antibodies and immune complexes that cause damage to the nephrons. Serum creatinine levels and urinalysis are used in screening for renal involvement. Early detection allows for prompt treatment so that renal damage can be prevented. Renal involvement may lead to hypertension, which also requires careful monitoring and management (see Chapter 25).

Central nervous system involvement is widespread, encompassing the entire range of neurologic disease. The varied and frequent neuropsychiatric presentations of SLE are now widely recognized and include psychosis, cognitive impairment, seizures, peripheral and cranial neuropathies, transverse myelitis, and strokes. These are generally demonstrated by subtle changes in behavior patterns or cognitive ability.

Assessment and Diagnostic Findings

Diagnosis of SLE is based on a complete history, physical examination, and blood tests. In addition to the general assessment performed for any patient with a rheumatic disease, assessment for known or suspected SLE has special features. The skin is inspected for erythematous rashes. Cutaneous erythematous plaques with an adherent scale may be observed on the scalp, face, or neck. Areas of hyperpigmentation or depigmentation may be noted, depending on the phase and type of disease. The patient should be questioned about skin changes (because these may be transitory) and specifically about sensitivity to sunlight or artificial ultraviolet light. The scalp should be inspected for alopecia and the mouth and throat for ulcerations reflecting gastrointestinal involvement.

Cardiovascular assessment includes auscultation for pericardial friction rub, possibly associated with myocarditis and accompanying pleural effusions. The pleural effusions and infiltrations, which reflect respiratory insufficiency, are demonstrated by abnormal lung sounds. Papular, erythematous, and purpuric lesions developing on the fingertips, elbows, toes, and extensor surfaces of the forearms or lateral sides of the hand that may become necrotic suggest vascular involvement.

Joint swelling, tenderness, warmth, pain on movement, stiffness, and edema may be detected on physical examination. The joint involvement is often symmetric and similar to that found in RA.

The neurologic assessment is directed at identifying and describing any central nervous system changes. The patient and family members are asked about any behavioral changes, including manifestations of neurosis or psychosis. Signs of depression are noted, as are reports of seizures, or other central nervous system manifestations.

The American College of Rheumatology has established criteria for the classification of SLE involving 11 distinct elements (American College of Rheumatology, 1997) (see Chart 57-5). The diagnosis of SLE is generally made if 4 of the 11 criteria are present, either serially or simultaneously.

The ANA is positive in more than 95% of patients with SLE, indicating exceptional specificity. Other laboratory tests include anti-DNA (antibody that develops against the patient's own DNA), anti-ds DNA (antibody against DNA that is highly specific to SLE, which helps differentiate it from drug-induced lupus), and anti-Sm (antibody against Sm, which is a specific protein found in the nucleus). Other blood work includes the CBC, which may reveal anemia, thrombocytopenia, leukocytosis, or leukopenia (Klippel et al., 2008).

Medical Management

SLE can be life-threatening, but advances in its treatment have led to improved survival and reduced morbidity. Acute disease requires interventions directed at controlling increased disease activity or exacerbations that can involve any organ system. Disease activity is a composite of clinical and laboratory features that reflect active inflammation secondary to SLE. Management of the more chronic condition involves periodic monitoring and recognition of meaningful clinical changes requiring adjustments in therapy.

The goals of treatment include preventing progressive loss of organ function, reducing the likelihood of acute disease, minimizing disease-related disabilities, and preventing complications from therapy. Management of SLE involves regular monitoring to assess disease activity and therapeutic effectiveness.

Chart 57-5

Criteria for Classifying Systemic Lupus Erythematosus

The American College of Rheumatology (ACR) established criteria for the classification of systemic lupus erythematosus (SLE) in 1982. These were updated in 1997, and include four cutaneous, four systemic, and three laboratory criteria. Diagnosis is determined by evaluating presenting signs and symptoms, laboratory results, and the patient's medical history and medical history of family members. The ACR-established criteria are as follows:

- Malar rash
- Discoid rash
- Photosensitivity
- Oral ulcers
- Nonerosive arthritis
- Pleuritis or pericarditis
- Kidney disease
- Neurologic disease
- Hematologic disorder
- Immunologic disorder
- Positive antinuclear antibody

Based on the 11 criteria above, a person is diagnosed with systemic lupus erythematosus if any 4 or more of the criteria are met at any time.

Reprinted with permission from Hochberg, C. (1997).Updating the American college of rheumatology revised criteria for the classification of systemic lupus erythematosus. Arthritis and Rheumatism, 40(9), 1725; Tan, E. M., Cohen, A. S., Fries, J. F., et al. (1982). The 1982 revised criteria for the classification of systemic lupus erythematosus. Arthritis and Rheumatism, 25(11), 1271–1277.

Pharmacologic Therapy

The mainstay of SLE treatment is based on pain management and nonspecific immunosuppression. Therapy includes monoclonal antibodies, corticosteroids, antimalarial agents, NSAIDs, and immunosuppressive agents. Each of these medications has potentially serious side effects, including organ damage.

Belimumab (Benlysta) is approved by the FDA for the treatment of SLE (Carter et al., 2015). Belimumab is a monoclonal antibody that specifically recognizes and binds to BLyS. BLyS acts to stimulate B cells to produce antibodies against the body's own nuclei, which is an integral part of the disease process in SLE. Belimumab acts to render BLyS inactive, preventing it from binding to B-cell surfaces and stimulating B-cell activity. This action then halts the production of unnecessary antibodies and decreases disease activity in SLE. Research suggests that belimumab reduces disease activity and flares in patients with SLE. Live vaccines are contraindicated while taking this medication, and caution should be used with all concurrent medications given the short duration that belimumab has been available.

Corticosteroids are another medication used topically for cutaneous manifestations, in low oral doses for minor disease activity, and in high doses for major disease activity. Intravenous (IV) administration of corticosteroids is an alternative to traditional high-dose oral administration. One of the most

important risk factors associated with the use of corticosteroids in SLE is osteoporosis and fractures. In fact, osteopenia is reported in 25% to 74% and osteoporosis in 1.4% to 68% of patients with SLE (Bultink, 2012).

An antimalarial medication approved by the FDA, hydroxychloroquine, is effective for managing cutaneous, musculoskeletal, and mild systemic features of SLE. The NSAIDs used for minor clinical manifestations are often used in conjunction with corticosteroids in an effort to minimize corticosteroid requirements.

Immunosuppressive agents (alkylating agents and purine analogues) are used because of their effect on overall immune function. These medications are generally reserved for patients who have serious forms of SLE that have not responded to conservative therapies. Examples include cyclophosphamide, azathioprine, mycophenolic acid (Myfortic), and methotrexate, which are contraindicated in pregnancy and have been used most frequently in SLE nephritis (Carter et al., 2015).

Nursing Management

Nursing care of the patient with SLE is based on the fundamental plan presented earlier in the chapter (see Chart 57-2). The most common nursing diagnoses include fatigue, impaired skin integrity, body image disturbance, and deficient knowledge for self-management decisions. The disease or its treatment may produce dramatic changes in appearance and considerable distress for the patient. The changes and the unpredictable course of SLE necessitate expert assessment skills and nursing care with sensitivity to the psychological reactions of the patient. In particular, patients with SLE report feelings of depression and anxiety as well as difficulty coping with the disease and the financial strain associated with it (Fonseca, Bernardes, Terroso, et al., 2014). The patient may benefit from participation in support groups, which can provide disease information, daily management tips, and social support. Because sun and ultraviolet light exposure can increase disease activity or cause an exacerbation, patients should be instructed to avoid exposure or to protect themselves with sunscreen and clothing.

Because of the increased risk of involvement of multiple organ systems, patients should understand the need for routine periodic screenings as well as health promotion activities. A dietary consultation may be indicated to ensure that the patient is knowledgeable about dietary recommendations, given the increased risk of cardiovascular disease, including hypertension and atherosclerosis. Smoking tobacco accelerates complications in patients with SLE (Chasset, Frances, Barete, et al., 2015). In the healthy population, smoking increases the incidence of respiratory infections, lung cancer, risk of coronary artery disease; increases blood pressure, which can worsen kidney function; inhibits liver function (which can also inhibit treatment medications from working appropriately, such as hydroxychloroquine); increases the risk for skin diseases; and increases the risk for osteoporosis. Patients diagnosed with SLE are at even higher risk of developing lung cancer and other rare cancers. Therefore, smoking cessation programs should be offered to all patients who report smoking habits (Montes, Mocarzel, Lanzieri, et al, 2016).

The nurse educates the patient about the importance of continuing prescribed medications and addresses the changes and potential side effects that are likely to occur with their use. The patient is reminded of the importance of monitoring because of the increased risk of systemic involvement, including renal and cardiovascular effects.

Because of the immunosuppression associated with systemic corticosteroid usage, the nurse must watch for signs and symptoms of infection, especially with acutely ill patients.

The nurse should also screen the patient for osteoporosis, because long-term use of corticosteroids increases the incidence of osteoporosis. Patients should have a bone mineral density test performed at diagnosis and prior to beginning steroid use to determine a baseline status and then every 2 years thereafter. Educating the patient regarding calcium and Vitamin D supplementation daily is encouraged, along with the benefits of weight-bearing activities to support bone health (Cash & Glass, 2015).

Sjögren's Syndrome

Sjögren's syndrome is a systemic autoimmune disease that progressively affects the lacrimal and salivary glands of the body. More than 90% of patients affected are women, and the onset tends to begin between 35 and 50 years of age (Carter et al., 2015).

It is one of the most common autoimmune disorders, affecting approximately 1 out of 1000 people or 2 to 4 million people in the United States (Carter et al., 2015). Sjögren's syndrome is reported rarely and is an uncommon disease in India. One rheumatology center that caters 35 million people reported only 26 patients were affected with Sjögren's syndrome in the 10 years period from 1990–2000 (Misra, Hissaria, Tandon et al., 2003). Sjögren's syndrome very commonly manifests in conjunction with other autoimmune diseases such as RA or SLE.

Pathophysiology

B-cell–mediated antibodies infiltrate the exocrine glands, leading to gland dysfunction and gland destruction. This phenomenon seems to be somewhat regulated by genetics (HLA subtype). There also appears to be environmental triggers such as viruses. Given the clinical makeup and antibodies present, it may also be that Sjögren's disease is a subtype of SLE (Klippel et al., 2008).

Clinical Manifestations

The most common symptoms involve dry eyes (keratoconjunctivitis sicca) and dry mouth (xerostomia). Some patients will complain that their eyes feel "gritty," as if there is sand present. The patient's eyes will exhibit increased redness and lack of tearing. These ocular symptoms can also lead to increased levels of anxiety and depression. The mouth will have dry and sticky mucous membranes. The reduced saliva production may lead to difficulty swallowing.

Sjögren's syndrome can also exhibit symptoms in many other organ systems. Vasculitis (5% to 10%) can manifest with palpable purpura on the skin (Quemeneur, Mouthon, Cacoub, et al., 2013). Lesions may ulcerate and can be painful. Optic neuritis, trigeminal neuralgia, and sensory neuropathy may be present, with symptoms such as burning pain in the extremities, numbness, vertigo, arthralgia, and/or myalgia. Raynaud's phenomenon, which involves blood vessel spasms leading to decreased circulation to the toes, fingers, nose and ears, is noted in 13% to 62% of patients (Klippel et al., 2008). Symptoms such as cough, dyspnea, and abdominal pain may also occur.

Assessment and Diagnostic Findings

The classification criteria for diagnosis of Sjögren's syndrome identify six distinct indices (Klippel et al., 2008):

- Ocular symptoms such as chronic dry eye (Keratoconjunctivitis Sicca).

- Positive ocular tests (evaluating tear production, corneal, and conjunctival damage). Ocular testing may include Schimer test or Rose Bengal staining tests.
- Oral symptoms, dry mouth.
- Histopathology evaluation (of salivary glands). This will help differentiate the cause of dry mouth from other causes, such as infection, malignancy, stones, and sarcoidosis.
- Salivary gland involvement.

Laboratory tests include autoantibodies to ribonucleoprotein particles (Ro[SS-A] and/or La[SS-B]), which act as antigens in this disease process. Other laboratory indices are also useful in diagnosing Sjögren's syndrome. Rheumatoid factor is present in 50% to 70% of patients. ANA, circulating DNA (cDNA), anti-CCP, and anticentromere antibody (ACA) are all potentially present in Sjögren's syndrome and in some cases may act as markers for disease activity (Moerman, Bootsma, Kroese, et al., 2013).

For vasculitis manifestations, a skin biopsy can yield useful information such as leukocytoclastic vasculitis found on histologic examination. If neurologic symptoms are present, nerve conduction studies, MRI, electroencephalograms, and cerebrospinal fluid testing may be used to aid in diagnosis and treatment planning.

Medical Management

There is no cure for Sjögren's syndrome, and treatment is aimed at symptom management. Artificial tears, drops such as pilocarpine (Piloptic), and ocular ointments such as topical cyclosporine are used for dry eyes. Tears normally drain through the lacrimal puncta to the nose, which can render artificial tears ineffective. Therefore, punctum plugs have become very important management tools. For dry mouth, systemic cholinergic agents such as cevimeline (Evoxac) are used regularly (Klippel et al., 2008). Biotene oral rinse may also be useful for some patients. Additional suggestions include eating small frequent meals; omitting spicy, salty, and irritating food; and avoiding smoking, excessive alcohol use, and drugs with anticholinergic side effects. For severe cases, biologic DMARDs such as rituximab and belimumab and nonbiologic DMARDs such as hydroxychloroquine are sometimes used, but evidence regarding their effectiveness is limited (Carter et al., 2015).

Nursing Management

Nursing care is based on the fundamental plan of nursing care presented earlier (see Chart 57-2). The most frequent nursing diagnoses for the patient with Sjögren's syndrome are altered skin integrity, self-care deficit, and deficient knowledge of self-management techniques.

The nurse is in the unique position to reinforce the treatment regimen with the patient, especially involving the ocular treatments to avoid sequelae-like eye infections secondary to the dry eyes.

Scleroderma

Scleroderma is a compilation of autoimmune diseases affecting the connective tissue of the skin, blood vessel walls, and internal organs. There are two general types: localized (affecting only the cutaneous system) and systemic (routinely referred to as systemic sclerosis and affecting multiple organ systems). Scleroderma is a rare disease affecting 250 patients per million population (Klippel et al., 2008). Similar to other autoimmune diseases, women are affected three to five times more than men, and the onset occurs typically between the ages of 30 and 50 years. African American patients are affected much younger and have more diffuse symptoms with more severe lung disease. Scleroderma has a variable course with remissions and exacerbations (Varga, 2014).

Pathophysiology

The pathogenesis is poorly understood. Scleroderma commonly begins with skin involvement. Mononuclear cells cluster on the skin and stimulate lymphokines to stimulate procollagen. Insoluble collagen is formed and accumulates excessively in the tissues. Initially, the inflammatory response causes edema, with a resulting taut, smooth, and shiny skin appearance. The skin then undergoes fibrotic changes, leading to loss of elasticity and movement. Eventually, the tissue degenerates and becomes nonfunctional. This chain of events, from inflammation to degeneration, also occurs in blood vessels, major organs, and body systems (Varga, 2014). Both genetics and environmental factors can influence the disease process.

Clinical Manifestations

Scleroderma starts insidiously with Raynaud's phenomenon and swelling in the hands. Raynaud's phenomenon is observed in 90% of patients with scleroderma and can precede the official scleroderma diagnosis for years (Varga, 2014). The skin and subcutaneous tissues become increasingly hard and rigid and cannot be pinched up from the underlying structures. Wrinkles and lines are obliterated. The skin is dry because sweat secretion over the involved region is suppressed. The extremities stiffen and lose mobility. The condition spreads slowly; for years, these changes may remain localized in the hands and the feet. The face appears masklike, immobile, and expressionless, and the mouth becomes rigid (Jordan, Maurer, Toniolo, et al., 2015).

The changes within the body, although not visible directly, are vastly more important than the visible changes. Pulmonary hypertension is one problem that can result and is the leading cause of related death (Varga & Steen, 2015). The esophagus hardens, interfering with swallowing. The lungs become scarred, impeding respiration. Digestive disturbances occur because of hardening (sclerosing) of the intestinal mucosa. Progressive kidney failure may occur.

The patient may manifest a variety of symptoms referred to as the CREST syndrome. *CREST* stands for *c*alcinosis (calcium deposits in the tissues), *R*aynaud's phenomenon, *e*sophageal hardening and dysfunction, *s*clerodactyly (scleroderma of the digits), and *t*elangiectasia (capillary dilation that forms a vascular lesion) (Papadakis et al., 2015).

Assessment and Diagnostic Findings

Assessment focuses on the sclerotic changes in the skin, contractures in the fingers, and color changes or lesions in the fingertips. Assessment of systemic involvement requires a systems review with special attention to gastrointestinal, pulmonary, renal, and cardiac symptoms. Limitations in mobility and self-care activities should be assessed, along with the impact the disease has had (or will have) on body image.

There is no one conclusive diagnostic test used to diagnose scleroderma. High-resolution CT is used to diagnose the presence of pulmonary hypertension. Pulmonary function tests and echocardiogram are recommended at diagnosis and yearly thereafter (Varga & Steen, 2015). Echocardiography identifies pericardial effusion (often present with cardiac involvement). Echocardiograms show some promise as well in detecting vascular changes in the early stages of the disease

process. Esophageal studies demonstrate decreased motility in most patients with scleroderma. Blood tests may detect ANAs, indicating a connective tissue disorder and possibly distinguishing the subgroup (diffuse or limited) of scleroderma. A positive ANA test result is common in patients with scleroderma (Varga, 2014).

Medical Management

Treatment of scleroderma depends on the clinical manifestations. All patients require counseling, during which realistic individual goals may be determined. Support measures include strategies to decrease pain and limit disability. A moderate exercise program is encouraged to prevent joint contractures. Patients are advised to avoid extreme temperatures and to use lotion to minimize skin dryness.

Pharmacologic Therapy

No medication regimen is effective in modifying the disease process in scleroderma, but various medications are used to treat organ system involvement. Calcium channel blockers and other antihypertensive agents may provide improvement in symptoms of Raynaud's phenomenon. Anti-inflammatory medications can be used to control arthralgia, stiffness, and general musculoskeletal discomfort. Proton pump inhibitors are used for symptoms of gastric reflux. Aspirin and HMG-CoA (3-hydroxy-3-methylglutaryl coenzyme A) reductase inhibitors (statins) are used to help reduce cardiovascular risk factors. Given the propensity toward digital ulcers due to Raynaud's phenomenon and the potential for pulmonary hypertension, vasoactive medications such as epoprostenol (Flolan), bosentan (Tracleer), and sildenafil (Viagra) are used. Immunosuppressive agents such as cyclophosphamide and methotrexate have been used to improve skin and lung function. The antifibrotic agent imatinib mesylate is used to decrease fibrosis in various organs. Ultraviolet A irradiation is sometimes used to decrease the synthesis of collagen in dermal fibrosis and improve skin symptoms (Carter et al., 2015).

Nursing Management

Nursing care of the patient with scleroderma is based on the fundamental plan of nursing care presented earlier (see Chart 57-2). The most common nursing diagnoses are impaired skin integrity; self-care deficits; imbalanced nutrition: less than body requirements; and disturbed body image. The patient with advanced disease may also have impaired gas exchange, decreased cardiac output, impaired swallowing, and constipation.

Providing meticulous skin care and preventing the effects of Raynaud's phenomenon are major nursing challenges. See Chapter 24 for further discussion of Raynaud's phenomenon.

Polymyositis

Polymyositis is a group of diseases that are termed *idiopathic inflammatory myopathies* (Klippel et al., 2008). They are rare conditions, with an incidence estimated at 2 cases per 10,000 adults per year. Polymyositis is most commonly seen in women versus men (2:1) and usually seen between 40 and 50 years of age (Miller & Viegels, 2016).

Pathophysiology

Polymyositis is classified as autoimmune because autoantibodies are present. However, these antibodies do not cause damage to muscle cells, indicating only an indirect role in tissue damage. The pathogenesis is multifactorial, and a genetic predisposition is likely. Drug-induced disease is rare.

Clinical Manifestations

The onset may be very slow and insidious, with symptoms gradually worsening over weeks to months. Proximal muscle weakness is typically the first symptom. Muscle weakness is usually symmetric and diffuse. Common complaints include having difficulty rising from a chair, climbing steps, or holding up the head. Myalgia and muscle tenderness occur in 25% to 50% of patients. Dermatomyositis, a related condition, is most commonly identified by an erythematous smooth or scaly lesion found over the joint surface, which often occurs prior to symptoms of weakness in 50% to 60% of patients (Miller & Viegels, 2016).

Assessment and Diagnostic Findings

A complete history and physical examination help exclude other muscle-related disorders. As with other diffuse connective tissue disorders, no single test confirms polymyositis. An electromyogram is performed to rule out degenerative muscle disease. A muscle biopsy may reveal inflammatory infiltrate in the tissue. Serum studies indicate increased muscle enzyme activity.

Medical Management

Management involves high-dose corticosteroid therapy initially, followed by a gradual dosage reduction over several months as muscle enzyme activity decreases. Patients who do not respond to corticosteroids require the addition of an immunosuppressive agent, such as azathioprine, methotrexate, cyclosporine, or cyclophosphamide. The IV immune globulin given in combination with corticosteroids or another immunosuppressive agent has been noted to be beneficial (Carter et al., 2015). Plasmapheresis, lymphapheresis, and total-body irradiation have been used if there is no response to corticosteroids and immunosuppressive medications. The antimalarial agent hydroxychloroquine may be effective for skin rashes. Physical therapy is initiated slowly, with range-of-motion exercises to maintain joint mobility, followed by gradual strengthening exercises (Klippel et al., 2008).

Nursing Management

Nursing care is based on the fundamental plan of nursing care presented earlier (see Chart 57-2). The most frequent nursing diagnoses for the patient with polymyositis are impaired physical mobility, fatigue, self-care deficit, and deficient knowledge of self-management techniques.

Patients with polymyositis may have symptoms similar to those of other inflammatory diseases. However, proximal muscle weakness is characteristic, making activities such as combing the hair, reaching overhead, and using stairs difficult. Therefore, the use of assistive devices may be recommended, and referral to occupational or physical therapy may be warranted.

Polymyalgia Rheumatica and Giant Cell Arteritis

PMR involves stiffness of muscles and pain in the neck, shoulder, and pelvic girdle. GCA is a form of vasculitis affecting the medium-sized and large arteries of the body (Klippel et al., 2008). GCA is also sometimes referred to as temporal arteritis because the majority of arteries affected are extracranial branches of the carotid artery. It is widely agreed, however, that both PMR and GCA represent a spectrum of one disease

(Papadakis et al., 2015). Both primarily affect individuals older than 50 years and are associated with the same HLA haplotype genetic markers. PMR and GCA occur predominately in Caucasians and often in first-degree relatives. PMR has an annual incidence rate of 52 cases per 100,000 people older than 50 years. GCA varies by geographic location and has the highest incidence in Scandinavian countries. PMR is two to three times more common than GCA (Klippel et al., 2008).

Pathophysiology

The underlying mechanism of action involved with PMR and GCA is unknown. It is clear, however, that the immune system is abnormally activated in both disease processes with increases in circulating monocytes that produce IL-1 and IL-6. These circulating monocytes make the endothelial linings of blood vessels more vulnerable to vasculitis (Klippel et al., 2008). Immunoglobulin deposits in the walls of inflamed temporal arteries suggest that an autoimmune process is at work.

Clinical Manifestations

PMR is characterized by severe proximal muscle discomfort with mild joint swelling. Severe aching in the neck, shoulder, and pelvic muscles is common. Stiffness is noticeable most often in the morning and after periods of inactivity. This stiffness can become so severe that patients struggle putting on a coat or combing their hair. Systemic features include low-grade fever, weight loss, malaise, anorexia, and depression. Because PMR usually occurs in people 50 years and older, it may be confused with, or dismissed as, an inevitable consequence of aging.

GCA may cause headaches, changes in vision, and jaw claudication. These symptoms should be evaluated immediately because of the potential for a sudden and permanent loss of vision if the condition is left untreated. PMR and GCA have a self-limited course, lasting several months to several years (Klippel et al., 2008).

Assessment and Diagnostic Findings

Assessment focuses on musculoskeletal tenderness, weakness, and decreased function. Careful attention should be directed toward assessing the head (for changes in vision, headaches, and jaw claudication). An MRI scan may be used in the assessment of extra-articular synovitis in patients with PMR, regardless of symptoms.

Often, diagnosis is difficult because of the lack of specificity of tests. A markedly high ESR is a screening test but is not definitive. The CRP level and platelet count also provide valuable data. In fact, simultaneous elevation in the ESR and CRP has a sensitivity of 98.6% and a specificity of 75.7% in making the diagnosis of GCA when coupled with clinical findings (Seetharaman, 2015). Diagnosis of both GCA and PMR is more likely to be made by eliminating other potential diagnoses. The dramatic and immediate response to treatment with corticosteroids is considered by some to be diagnostic.

In the case of GCA, biopsy of the temporal artery is the definitive diagnostic tool (Seetharaman, 2015). High-resolution MRI is an alternative or adjunct to the traditional temporal artery biopsy.

Medical Management

The treatment for patients with PMR (without GCA) is moderate doses of corticosteroids. Longer durations of corticosteroid treatment are required with patients who have higher baseline inflammatory markers. Gradual tapering of the corticosteroid treatment should be monitored. NSAIDs are sometimes given in mild disease. The treatment for patients with GCA is rapid initiation of and strict adherence to a regimen of corticosteroids. This is essential to avoid the complication of blindness. Aspirin is a useful adjunctive treatment that also helps reduce the risk of visual loss (Yurdakul, Bodur, Sivas, et al., 2015).

Nursing Management

Nursing care of the patient with PMR is based on the fundamental plan of nursing care presented earlier (see Chart 57-2). The most common nursing diagnoses are pain and deficient knowledge of medications.

A management concern is that the patient will take the prescribed medication, frequently corticosteroids, until symptoms improve and then discontinue the medication. The decision to discontinue the medication should be based on clinical and laboratory findings and the prescription. Nursing implications are related to helping the patient prevent and monitor adverse effects of medications (e.g., infections, diabetes, gastrointestinal problems, and depression) and adjust to those side effects that cannot be prevented (e.g., increased appetite and altered body image).

Nursing Alert: The nurse must emphasize to the patient the need for continued adherence to the prescribed medication regimen to avoid complications of GCA, such as blindness.

The loss of bone mass with corticosteroid use increases the risk of osteoporosis in this already at-risk population. Interventions to promote bone health, such as adequate dietary calcium and vitamin D, measurement of bone mineral density, weight-bearing exercise, smoking cessation, and reduction of alcohol consumption if indicated, should be emphasized.

Osteoarthritis (Degenerative Joint Disease)

OA is a noninflammatory degenerative disorder of the joints. It is the most common form of joint disease and is routinely referred to as degenerative joint disease. OA is classified as either primary (idiopathic), with no prior event or disease related to the OA, or secondary, resulting from previous joint injury or inflammatory disease, similar to RA (Papadakis et al., 2015). Unlike most of the disease processes discussed in this chapter, the pathophysiology of primary OA does not involve autoimmunity or inflammation. It can occur as an end result of an autoimmune disorder where joint destruction occurs. Another distinguishing characteristic of OA is that it is limited to the affected joints; there are no systemic symptoms associated with it.

OA often begins in the third decade of life and peaks between the fifth and sixth decades. By 40 years of age, 90% of the population has degenerative joint changes in their weight-bearing joints, even though clinical symptoms are usually absent (Papadakis et al., 2015). Women, especially those who are Hispanic or African American, are more commonly affected. The incidence of OA increases with age. It is estimated that over 85% of the general population over 65 years of age has radiographic changes indicating OA (Cash & Glass, 2015). Overall prevalence of knee osteoarthritis among Indian population was 28.7%, with women having higher prevalence (31.6%) than men (Prakash Pal, Singh, & Chaturvedi et Al., 2016). Although OA is usually thought of as a disease of aging, it also affects younger patients and results in significant losses in work-related productivity and higher costs (CDC, 2015).

Pathophysiology

All joints consist of bone, particularly subchondral bone or the bony plate to which the articular cartilage is attached. This articular cartilage is a lubricated, smooth tissue that protects the bone from damage with physical activity. Between the articular cartilage of the bones forming the joint is a space (called the *joint space*) that allows for movement. To aid in fluidity, each joint contains synovial fluid to help lubricate and protect the joint's movement. With OA, the articular cartilage breaks down, leading to progressive damage to the underlying bone and eventual formation of **osteophytes** (bone spurs) that protrude into the joint space. The result is that the joint space is narrowed, leading to decreased joint movement and the potential for more damage. Consequently, the joint can progressively degenerate (see Fig. 57-3). Understanding of OA pathophysiology has been greatly expanded beyond what was previously thought of as simply "wear and tear" related to aging. The basic degenerative process in the joint exemplified in OA is presented in Figure 57-4. In addition to the degeneration, an infectious arteritis can occur. See Chapter 37 for discussion of septic (infectious) arthritis.

Risk factors for the disease and its progression include older age, female gender, and obesity. In addition, certain occupations (e.g., those requiring laborious tasks); engaging in sport activities; and a history of previous injuries, muscle weakness, genetic predisposition, and certain diseases can also place patients at risk for joint destruction. The most prominent modifiable risk factor for OA is obesity. In fact, both quality and quantity of life are reduced with OA, especially when obesity and OA are combined. A program of diet and exercise can help minimize symptoms of OA in patients who are obese (CDC, 2015).

Clinical Manifestations

The main clinical manifestations of OA are pain, stiffness, and functional impairment. The joint pain is usually aggravated by movement or exercise and relieved by rest. If morning stiffness is present, it is usually brief, lasting less than 30 minutes. The onset is routinely insidious, progressing over multiple years.

On physical examination, the affected joint may be enlarged with a decreased range of motion. Although OA occurs most often in weight-bearing joints (hips, knees, cervical and lumbar spine), the proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints are also often involved causing bony enlargements of the DIP (Heberden's nodes) and PIP (Bouchard's nodes) joints. Crepitus may be palpated, especially over the knee. Joint effusion, a sign of inflammation, is usually mild. No systemic manifestations are found.

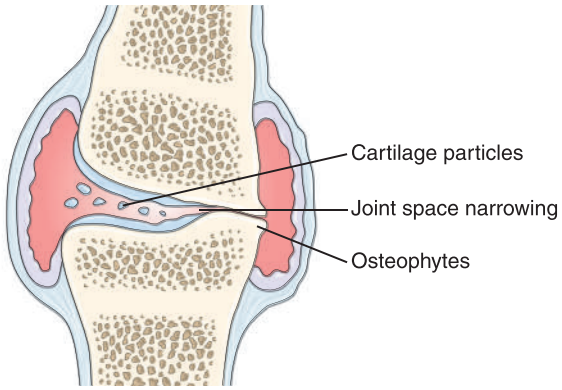


Figure 57-3 • Joint space narrowing and osteophytes (bone spurs) are characteristic of degenerative changes in joints.

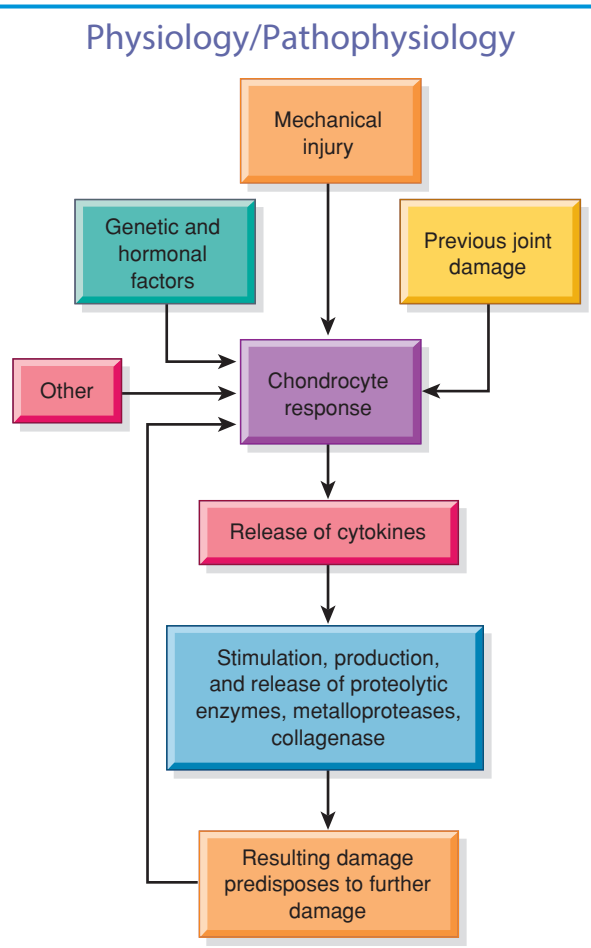


Figure 57-4 • Pathophysiology of osteoarthritis.

Assessment and Diagnostic Findings

Blood tests and examination of joint fluid are not useful in the diagnosis of OA but are occasionally indicated to rule out an autoimmune cause for the joint pain, such as RA. X-rays may show a narrowing of the joint space; osteophyte formation; and dense, thickened subchondral bone (Papadakis et al., 2015).

Medical Management

The goals of management are to decrease pain and stiffness and to maintain or, when possible, improve joint mobility. Exercise, especially in the form of cardiovascular aerobic exercise and lower extremity strength training, has been found to prevent OA progression and decrease symptoms of OA. Along with exercise, weight loss, which in turn decreases excess load on the joint, can also be extremely beneficial. Occupational and physical therapy can help the patient adopt self-management strategies (Kalunian, 2015a).

Wedged insoles, knee braces, and other modalities are being evaluated as possible therapies aimed at treating the abnormalities in biomechanics found in OA. The use of orthotic devices (e.g., splints, braces) and walking aids (e.g., canes) can improve pain and function by decreasing force on the affected joint (Kalunian, 2015a).

Patients with arthritis often use complementary, alternative, and integrative health therapies, such as massage, yoga, pulsed electromagnetic fields, TENS, and music therapy. These may also include herbal and dietary supplements, other special diets, acupuncture, acupressure, wearing copper bracelets or magnets, and participation in Tai chi. Research is under way to determine the effectiveness of many of these treatments. To date, no definitive evidence has been found regarding their efficacy (Kalunian, 2015a).

Pharmacologic Therapy

Pharmacologic management of OA is directed toward symptom management and pain control. Selection of medication is based on the patient's needs, the stage of disease, and the risk of side effects. Medications are used in conjunction with nonpharmacologic strategies. In most patients with OA, the initial analgesic therapy is acetaminophen/paracetamol. Some patients respond to the nonselective NSAIDs, and patients who are at increased risk for gastrointestinal complications, especially gastrointestinal bleeding, have been managed effectively with COX-2 enzyme blockers. However, COX-2 enzyme blockers must be used with caution because of the associated risk of cardiovascular disease. Other medications that may be considered are the opioids and intra-articular corticosteroids. Topical analgesic agents such as capsaicin (Capsin, Zostrix) and methyl salicylate are also used (Carter et al., 2015). Topical diclofenac sodium gel (Voltaren gel) has been FDA approved for the use of osteoarthritic joint pain in the hands and knees.

Other therapeutic approaches include glucosamine and chondroitin. Although it has been suggested that these substances modify cartilage structure, studies have not shown them to be effective (Martin, Van Sell, & Danter, 2012). Viscosupplementation, the injection of gel-like substances (hyaluronates) into a joint (intra-articular), is thought to supplement the viscous properties of synovial fluid. These viscosupplements aim to prevent the loss of cartilage and repair chondral defects (Kalunian, 2015b).

Surgical Management

In moderate to severe OA, when pain is severe or because of loss of function, surgical intervention may be used. The procedures most commonly used are osteotomy (to alter the distribution of weight within the joint) and arthroplasty. In arthroplasty, diseased joint components are replaced (see Chapter 36). Rehabilitation with physical therapy that is initiated within the first 24 hours is associated with decreased hospital length of stay and improved balance and gait function (Martin, Thornhill, & Katz, 2015).

Nursing Management

Pain management and optimal functional ability are major goals of nursing intervention. With those goals in mind, nursing management of the patient with OA includes pharmacologic and nonpharmacologic approaches as well as education. The patient's understanding of the disease process and symptom pattern is critical to the plan of care. Because patients with OA usually are older, they may have other health problems. Commonly they are overweight, and they may have a sedentary lifestyle. Weight loss and exercise are important approaches to lessen pain and disability. Canes or other assistive devices for ambulation should be considered, and any stigma about the use of these devices should be explored. Exercises such as walking should be begun in moderation and increased gradually. Patients should plan their daily exercise for a time when the pain is least severe or plan to use an analgesic agent, if appropriate, before exercising. Adequate pain management is important for the success of an exercise program. Open discussion regarding the use of complementary, alternative, and integrative health therapies is important to maintain safe and effective practices for patients looking for relief.

Spondyloarthropathies

The spondyloarthropathies are another category of systemic inflammatory disorders of the skeleton. The spondyloarthropathies include ankylosing spondylitis (AS), reactive arthritis (formerly known as Reiter's syndrome), and psoriatic arthritis. Spondyloarthritis is also associated with inflammatory bowel diseases such as Crohn's disease (regional enteritis) and ulcerative colitis (Grossman & Porth, 2014).

These rheumatic diseases share several clinical features. The inflammation tends to occur peripherally at the sites of attachment—at tendons, joint capsules, and ligaments. Periosteal inflammation may be present. Many patients have arthritis of the sacroiliac joints. The onset tends to occur during young adulthood, with the disease affecting men more often than women. There is a strong tendency for these conditions to occur in families. Frequently, the HLA-B27 genetic marker is found. In addition, more than one of these conditions can be found simultaneously in the same person or another family member (Carter et al., 2015).

As with other inflammatory conditions, patients with spondyloarthropathies have an increased risk for cardiovascular disease. These findings may be related to a state of chronic systemic inflammation and an increase in traditional cardiac risk factors, such as lack of exercise due to increased pain (Carter et al., 2015).

Ankylosing Spondylitis

AS is a chronic and inflammatory disease of the spine. It is more prevalent in males than in females and is usually diagnosed in the second or third decade of life. The disease is also more severe in males, and significant systemic involvement is likely.

AS affects the cartilaginous joints of the spine and surrounding tissues, making them rigid, decreasing mobility, and leading to kyphosis (a stooped position). This kyphosis can, in turn, lead to decreased stability and balance. Back pain is the characteristic feature. The back pain can be so severe that it may mask symptoms of a cervical fracture, which can lead to neurologic problems if left untreated. Occasionally, the large synovial joints, such as the hips, knees, or shoulders, may be involved (Carter et al., 2015).

AS also exhibits systemic effects. Uveitis occurs in 20% to 25% of patients with AS and may be a presenting feature (Smith, 2013). Another potential complication of AS is the risk of osteoporosis, which appears to be related to the inflammatory process as well as bone turnover and low vitamin D levels. Other complications involve atrioventricular conduction defects, aortic insufficiency, and pulmonary fibrosis (Papadakis et al., 2015). As the disease progresses, ankylosis of the entire spine may occur, leading to respiratory compromise and further complications.

Reactive Arthritis (Reiter's Syndrome)

The disease process involved in reactive arthritis is called *reactive* because the arthritis occurs after an infection, primarily gastrointestinal or genitourinary (Carter et al., 2015). It mostly

affects young adult males and is characterized primarily by urethritis, arthritis, and conjunctivitis. Dermatitis and ulcerations of the mouth and penis may also be present. Low back pain is common.

Psoriatic Arthritis

Psoriatic arthritis is an inflammatory arthritis associated with the skin disease psoriasis. In fact, research has suggested that between 10% and 20% of people with psoriasis will eventually develop psoriatic arthritis (Carter et al., 2015); (Dewing, 2015). Psoriasis is the most common autoimmune disease in India, affecting 1.2% to 2.8% of the population (Dogra & Yadav, 2010). Psoriatic arthritis onset occurs between 30 and 50 years of age and affects equal numbers of men and women (Dewing, 2015). Age and sex adjusted psoriatic arthritis prevalence is 0.01% among Indians (Chopra, 2015).

Pathogenesis of the disease process is hypothesized to start in the skin with an exaggerated immune response to environmental factors and then spreads to the joints in genetically susceptible individuals. Genetics is found to be a strong predictor. Many men and women diagnosed with psoriatic arthritis usually have a first-degree relative with psoriasis. Research shows that the HLAs are also present in up to 50% of patients diagnosed with psoriatic arthritis testing positive for the HLA-B27 antigen (Dewing, 2015). Although these patients test negative for rheumatoid factor, levels of TNF-α and other cytokines are elevated (Dewing, 2015). The body is triggered to activate the T cells of the immune system, producing inflammatory cytokines and mediators that cause changes and inflammation in the body, which also may result in erosions and joint destruction. In addition to joint damage, this cascade may also damage the ligaments, tendons, skin, and nails. Nail psoriasis occurs in approximately 90% of patients (Dewing, 2015).

Psoriatic arthritis is characterized by synovitis, polyarthritis, and spondylitis. Inflammatory back pain is a common symptom, which is differentiated from other back pain by symptoms of back pain presenting at a young age, pain improving with activity, and pain occurring at night. Radiographic evidence of asymmetrical sacroiliitis or spondylitis may also assist with diagnosing psoriatic arthritis (Dewing, 2015). Other sites of pain commonly seen in these patients are the Achilles tendon, plantar fascia, or tibial tuberosity areas. Pain in these areas is common from the inflammation that occurs at the entheses, where tendons and ligaments attach to the bone.

In addition to pain, infections can also occur since this is a systemic disease. Uveitis occurs in approximately 1.5% to 25% of patients diagnosed with psoriatic arthritis. Uveitis should be quickly diagnosed and treated by the ophthalmologist to prevent vision loss (Dewing, 2015).

Medical Management

Medical management of spondyloarthropathies focuses on treating pain and maintaining mobility by suppressing inflammation. For the patient with AS, good body positioning and posture are essential so that if ankylosis (fixation) does occur, the patient is in the most functional position. Maintaining range of motion with regular exercise and a muscle-strengthening program is especially important and has been linked with higher quality of life for the patient (Carter et al., 2015).

Pharmacologic Management

The European League Against Rheumatism guidelines recommend NSAIDs as the first-line therapy for treating all spondylarthropathies. All chronic conditions (cardiac, renal, and gastrointestinal) should be taken into consideration when prescribing long-term NSAIDS. Methotrexate, sulfasalazine, and leflunomide may also be used; these drugs may help with skin and peripheral joint disease but may not prevent spinal changes. Corticosteroid injections may be used for periodic flares; however, oral and long-term use of steroids is not recommended due to the possibility of psoriatic skin flare when discontinuing use. More recently, anti-TNF therapy has been approved by the FDA for psoriatic arthritis. Anti-TNF medications that have been used effectively include etanercept (Enbrel), infliximab (Remicade), adalimumab (Humira), golimumab (Simponi), and certolizumab pegol (Cimzia). Two additional agents include apremilast (Otezla), which is a PDE4 inhibitor, and ustekinumab (Stelara), an anti-IL12/anti-IL23 agent (Carter et al., 2015); (Dewing, 2015).

Surgical Management

With advanced AS and subsequent debilitating kyphosis, an osteotomy of the spine can be done. One study showed that an average correction of 45 degrees in the cervical spine was obtained and that quality of life also improved. Surgical management may also include total joint replacement (see Chapter 36) (Carter et al., 2015).

Nursing Management

Major nursing interventions in the spondyloarthropathies are related to symptom management and maintenance of optimal functioning. Affected patients are primarily young men. Their major concerns are often related to prognosis and job modification, especially among those who perform physical work. Patients may also express concerns about leisure and recreational activities. Focusing on physical activity and staying active and maintaining good posture will help to prevent chronic changes that may lead to deformities. It is important to address psychological changes, such as depression and emotional stress, that can occur with the diagnosis and chronicity of the disease (Carter et al., 2015). If symptoms are present, the primary provider should assess for emotional stress and treat as appropriate.

Metabolic and Endocrine Diseases Associated with Rheumatic Disorders

Metabolic and endocrine diseases may be associated with rheumatic disorders. These include biochemical abnormalities (amyloidosis and scurvy), endocrine diseases (diabetes and acromegaly), immune deficiency diseases (human immune deficiency virus infection, acquired immune deficiency syndrome), and some inherited disorders (hypermobility syndromes). However, the most common conditions are the crystal-induced arthropathies, in which crystals such as monosodium urate (gout) or calcium pyrophosphate (calcium pyrophosphate dihydrate disease or pseudogout) are deposited within joints and other tissues (Papadakis et al., 2015).

Gout

Gout is the most common form of inflammatory arthritis. More than 8.3 million Americans self-report the diagnosis of gout (CDC, 2015b). The prevalence is reported to be about 3.9% and appears to be on the rise. Men are three to four times more likely to be diagnosed with gout than women. The prevalence of gouty arthritis is less in Indians (0.05%) compared to the western

population (Chopra, 2015). The incidence of gout increases with age, body mass index, alcohol consumption, hypertension, and diuretic use (CDC, 2015b). Evidence links the consumption of fructose-rich beverages with the risk of gout for both men and women (CDC, 2015b). Patients with gout have an increased risk of cardiovascular disease. Comorbid conditions such as hypertension, dyslipidemia, diabetes, OA, and kidney disease may be present in patients with gout (Papadakis et al., 2015).

Given that the incidence of gout increases with age, its management can be complicated by other medical conditions, medications, and age-related changes (Carter et al., 2015).

Pathophysiology

Gout is caused by hyperuricemia (increased serum uric acid). Uric acid is a by-product of purine metabolism; purines are basic chemical compounds found in high concentrations in meat products. Urate levels are affected by diet, medications, overproduction in the body, and inadequate excretion by the kidneys. Hyperuricemia (serum concentration greater than 6.8 mg/dL) can, but does not always, cause urate crystal deposition. However, as uric acid levels increase, the risk becomes greater. The initial cause for the gout attack occurs when macrophages in the joint space phagocytize urate crystals. Through a series of immunologic steps, interleukin 1 beta is secreted, increasing the inflammation. This process is exacerbated by the presence of free fatty acids. Both alcohol and consumption of a large meal, especially with red meat, can lead to increases in free fatty acid concentrations; they also are implicated as triggers to acute gout attacks (Carter et al., 2015).

With repeated attacks, accumulations of sodium urate crystals, called tophi, are deposited in peripheral areas of the body, such as the great toe, the hands, and the ear. Renal urate lithiasis (kidney stones), with chronic kidney disease secondary to urate deposition, may develop.

Primary hyperuricemia may be caused by severe dieting or starvation, excessive intake of foods that are high in purines (shellfish, organ meats), or heredity. In secondary hyperuricemia, gout is a clinical feature secondary to any of a number of genetic or acquired processes, including conditions in which there is an increase in cell turnover (leukemia, multiple myeloma, some types of anemias, psoriasis) and an increase in cell breakdown. Altered renal tubular function, either as a major action or as an unintended side effect of certain pharmacologic agents (e.g., diuretics such as thiazides and furosemide), low-dose salicylates, or ethanol can contribute to uric acid underexcretion (Klippel et al., 2008). The finding of urate crystals in the synovial fluid of asymptomatic joints suggests that factors other than crystals may be related to the inflammatory reaction. Recovered monosodium urate crystals are coated with immunoglobulins that are mainly IgG. IgG enhances crystal phagocytosis, thereby demonstrating immunologic activity (Klippel et al., 2008).

Clinical Manifestations

Manifestations of the gout syndrome include acute gouty arthritis (recurrent attacks of severe articular and periarticular inflammation), tophi (crystalline deposits accumulating in articular tissue, osseous tissue, soft tissue, and cartilage), gouty nephropathy (renal impairment), and uric acid urinary calculi. Four stages of gout can be identified: asymptomatic hyperuricemia, acute gouty arthritis, intercritical gout, and chronic tophaceous gout (Neoai, Jansen, Dalbeth, et al., 2015). The subsequent development of gout is directly related to the duration and magnitude of the hyperuricemia. Therefore, the commitment to lifelong pharmacologic treatment of hyperuricemia is deferred until there is an initial attack of gout.

For hyperuricemic people who are going to develop gout, acute arthritis is the most common early clinical manifestation. The metatarsophalangeal joint of the big toe is a commonly affected joint. The tarsal area, ankle, or knee may also be affected. Less commonly, the wrists, fingers, and elbows may be affected. Trauma, alcohol ingestion, dieting, medications, surgical stress, or illness may trigger the acute attack. The abrupt onset often occurs at night, awakening the patient with severe pain, redness, swelling, and warmth of the affected joint. Early attacks tend to subside spontaneously over 3 to 10 days even without treatment. The attack is followed by a symptom-free period (the intercritical stage) until the next attack, which may not come for months or years. However, with time, attacks tend to occur more frequently, involve more joints, and last longer (Becker, 2015).

Tophi (seen in chronic tophaceous gout) are generally associated with more frequent and severe inflammatory episodes. Higher serum concentrations of uric acid are also associated with more extensive tophus formation. Tophi most commonly occur in the synovium, olecranon bursa, subchondral bone, infrapatellar and Achilles tendons, and subcutaneous tissue on the extensor surface of the forearms and overlying joints. They have also been found in the aortic walls, heart valves, nasal and ear cartilage, eyelids, cornea, and sclera. Joint enlargement may cause a loss of joint motion. Uric acid deposits may cause renal stones and kidney damage.

Medical Management

A definitive diagnosis of gouty arthritis is established by polarized light microscopy of the synovial fluid of the involved joint. Uric acid crystals are seen within the polymorphonuclear leukocytes in the fluid.

Acute attacks are managed with colchicine (Colcrys) (oral or parenteral), an NSAID such as indomethacin (Indocin), or a corticosteroid. Management of hyperuricemia, tophi, joint destruction, and renal disorders is usually initiated after the acute inflammatory process has subsided. Once the acute attack has subsided, uric acid lowering therapy should be considered. Xanthine oxidase inhibitors, such as allopurinol (Zyloprim) and febuxostat (Uloric), are the agents of choice. Given the role of IL-1 in the pathogenesis of gout, some experts suggest that there may be a role for anakinra (Kineret), an IL-1 receptor antagonist in the management of acute gout (Papadakis et al., 2015).

Management between gout attacks needs to include lifestyle changes such as avoiding purine-rich foods, weight loss, decreasing alcohol consumption, and avoiding certain medications. Uricosuric agents, such as probenecid (Benemid), may be indicated in patients with frequent acute attacks. Uricosuric medications correct hyperuricemia and dissolve deposited urate. Corticosteroids may also be used in patients who have no response to other therapy. In patients with refractory chronic gout who are not controlled with the regimens mentioned earlier, pegloticase (Krystexxa), a newer agent, has been shown to be effective in lowering uric acid levels (Becker, 2016). Specific treatment is based on the serum uric acid level, 24-hour urinary uric acid excretion, and renal function (see Table 57-5) (Carter et al., 2015).

Nursing Management

Severe dietary restriction is not necessary; however, the nurse encourages the patient to restrict consumption of foods high in purines, especially organ meats, and to limit alcohol intake.

TABLE 57-5 Common Medications Used to Treat Gout

Medication	Actions and Use	Nursing Implications
Colchicine (Colcrys)	Lowers the deposition of uric acid and interferes with leukocyte infiltration, thus reducing inflammation; does not alter serum or urine levels of uric acid; used in acute and chronic management	*Acute management*: Administer when attack begins; dosage increased until pain is relieved or diarrhea develops, then stop medication *Chronic management*: Causes gastrointestinal upset in most patients.
Probenecid (Benemid)	Uricosuric agent; inhibits renal reabsorption of urates and increases the urinary excretion of uric acid; prevents tophi formation	Be alert for nausea and rash.
Allopurinol (Zyloprim), febuxostat (Uloric)	Xanthine oxidase inhibitors; interrupt the breakdown of purines before uric acid is formed; inhibit xanthine oxidase because uric acid formation is blocked	Monitor for side effects, including bone marrow depression, vomiting, and abdominal pain. Avoid starting medication or increasing dose if active flare present.

Adapted from Karch, A. (2014). Lippincott's nursing drug guide. Philadelphia, PA: Lippincott Williams & Wilkins.

Maintenance of normal body weight should be encouraged. In an acute episode of gouty arthritis, pain management with prescribed medications is essential, along with avoidance of factors that increase pain and inflammation, such as trauma, stress, and alcohol. Medication adherence is critical; therefore, counseling needs to be initiated by the nurse when appropriate. Between acute episodes, the patient feels well and may abandon preventive behaviors, which may result in an acute attack. Acute attacks are most effectively treated if therapy is begun early (Carter et al., 2015).

Fibromyalgia

Fibromyalgia is a chronic pain syndrome that involves chronic fatigue, generalized muscle aching, stiffness, sleep disturbances, and functional impairment. It is estimated to affect more than 5 million Americans, representing 2% to 5% of the general population, with women affected more than men. Between 25% and 65% of patients with fibromyalgia have other rheumatologic conditions such as RA, SLE, and AS (CDC, 2015c). Fibromyalgia is reported to be 3.8% in urban areas and 4.5% in rural localities in India (Chopra, 2015).

Pathophysiology

The amplified pain experienced by patients with fibromyalgia is neurogenic in origin (Carter et al., 2015). Specifically, the central nervous system's ascending and descending pathways (that regulate and moderate pain processing) function abnormally, causing amplification of pain signals. Some scientists describe this as if the "volume control setting" for pain were abnormally high (Carter et al., 2015). Therefore, stimulation that may not normally elicit pain, such as touch, may do so. In addition, there are a number of predisposing factors to pain, including anxiety, depression, physical trauma, emotional stress, sleep disorder, and viral infection (Carter et al., 2015).

Assessment and Diagnostic Findings

The American College of Rheumatology established preliminary diagnostic criteria and symptom severity indices for fibromyalgia (Carter et al., 2015). These criteria emphasize the regions of pain, rather than specific points, and take into account the fatigue, cognitive symptoms, and unrefreshed sleep that patients with fibromyalgia also tend to experience (Carter et al., 2015).

Medical Management

Treatment consists of attention to the specific symptoms reported by the patient. NSAIDs may be used to treat the diffuse muscle aching and stiffness. Tricyclic antidepressants such as amitriptyline (Elavil) and nortriptyline (Pamelor) as well as sleep hygiene measures are used to improve or restore normal sleep patterns (Cash & Glass, 2015). Muscle relaxants such as cyclobenzaprine (Amrix) may also be used to help with relaxation and pain. Cognitive behavioral therapy is also useful in improving sleep and attentional dysfunction. In addition, serotonin norepinephrine reuptake inhibitors, such as duloxetine (Cymbalta), venlafaxine (Effexor), and milnacipran (Savella); selective serotonin reuptake inhibitors, including fluoxetine (Prozac), paroxetine (Paxil), and sertraline (Zoloft); as well as anticonvulsants such as gabapentin (Neurontin) and pregabalin (Lyrica) have been reported to be effective (Carter et al., 2015). Individualized programs of exercise are used to decrease muscle weakness and discomfort and to improve the general deconditioning that occurs in affected patients. There has also been some promising research in complementary, alternative, and integrative health therapies, such as acupuncture, massage, homeopathy, hydrotherapy, craniosacral therapy, and myofascial therapy (Carter et al., 2015).

Nursing Management

Typically, patients with fibromyalgia have endured their symptoms for a long period of time. They may feel as if their symptoms have not been taken seriously. Nurses need to pay special attention to supporting these patients and providing encouragement as they begin their program of therapy. Careful listening to patients' descriptions of their concerns and symptoms is essential to help them make the changes that are necessary to improve their quality of life (Carter et al., 2015).

Miscellaneous Disorders

The last category in the classification of the rheumatic diseases is aptly labeled miscellaneous disorders because it contains a mix of disorders that are frequently associated with arthritis and other conditions. These include the direct consequences of trauma (including internal derangement and loose bodies of joints), pancreatic disease (related to avascular necrosis or osteonecrosis), sarcoidosis (a multisystem disorder particularly of the lymph nodes and lungs), and palindromic rheumatism (an uncommon variety of recurring and acute arthritis and periarthritis that in some may progress to RA but is characterized by symptom-free periods of days to months). Other conditions include villonodular synovitis, chronic active hepatitis, and drug-related rheumatic syndromes. The nursing interventions related to these varied conditions are specific

to the multisystemic problems experienced by the patient. However, the musculoskeletal components should not be neglected or overlooked. Further information about these rare disorders can be found in specialty references.

CRITICAL THINKING EXERCISES

1. A 62-year-old patient who was recently diagnosed with osteoarthritis (OA) comes in for her follow-up appointment. She wants to know why she is not being prescribed "stronger medications" for her arthritis like her friend is taking. Her friend has RA and her pain improved significantly after starting adalimumab injections. Describe your teaching plan to explain the physiologic differences between OA and RA, medications commonly used for OA and the difference between treatment regimens for OA and RA.
2. Your patient is a 52-year-old male patient with a history of hypertension, stage 3 kidney disease, diabetes, and hyperlipidemia. He smokes 1 pack of cigarettes a day and drinks alcohol on occasion. He is 6'2" and weighs 110 kg. Today he presents with complaints of severe pain in his right great toe that started Sunday morning. He spent a long weekend with friends, drank a lot of alcohol, and ate a lot of rich food. He woke Sunday morning with pain in his foot that has progressively gotten worse. He has been diagnosed with gout. Identify the priorities, approach, and techniques you would use to provide nursing care to this patient. How would you prioritize the physical examination and techniques performed since his pain scale is 8/10? What lifestyle modifications are a priority for this patient?
3. You are the nurse taking care of a woman with Sjögren's syndrome. What is the evidence for symptom management for this patient? What criteria would you use to assess the strength of the evidence? What is the evidence for treatment options to improve her symptoms?

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

Cash, J. C., & Glass, C. A. (2015). Adult-gerontology practice guidelines. New York: Springer Publishing Company.

Carter S. C., Patty-Resk, C., Ruffing, V., et al. (2015). Core curriculum for rheumatology nursing (1st ed.).Greenville, SC: Lyons Den Solutions, LLC.

Fischbach, F., & Dunning, M. B. (2015). A manual of laboratory and diagnostic tests (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Karch, A. (2014). Lippincott's nursing drug guide. Philadelphia, PA: Lippincott Williams & Wilkins.

**Klippel, J. H., Stone, J. H., Crofford, L. J., et al. (Eds.). (2008). Primer on the rheumatic diseases (13th ed.). New York: Springer.

Miller, C. A. (2015). Nursing for wellness in older adults (7th ed.). Philadelphia: Lippincott Williams & Wilkins.

Papadakis, M. A., McPhee, S. J., & Rabow, M. W. (2015). Current medical diagnosis and treatment 2016 (55th ed.). New York: McGraw-Hill.

Journals and Electronic Documents

Afshar, B. (2015). *RA: Best and worse supplements and herbs*. Retrieved on 5/14/2016 at: www.webmd.com/rheumatoid-arthritis/guide/rheumatoid-arthritis-best-wrose-supplements-herbs.

American College of Rheumatology (1997). *ACR-endorsed criteria for Rheumatic diseases*. Retrieved on 1/13/2016 at: www.rheumatology.org/Portals/0/Files/1997%20Update%20of%201982%20Revised.pdf

**Aletaha, D., Neogi, T., Silman, A. J., et al. (2010). 2010 Rheumatoid arthritis classification criteria: An American College of Rheumatology/European League Against Rheumatism collaborative initiative. Arthritis and Rheumatism, 62(9), 2569–2581.

Barbour, K. E., Helmick, C. G., Theis, K. A., et al. (2013). Prevalence of doctor-diagnosed arthritis and arthritis-attributable activity limitation—United States, 2010–2012. MMWR: Morbidity and Mortality Weekly Report, 62(44), 869–873.

Bartels, C. (2015). *Systemic Lupus Erythematosus*. Retrieved on 5/14/2016 at: www.emedicine.medscape.com/article/332244-overview.

Becker, M. A. (2015). Clinical manifestations and diagnosis of gout. Retrieved on 5/14/2016 at: www.uptodate.com/contents/search?search=Clinical+manifestations+and+diagnosis+of+gout&x=4&y=8

Becker, M.A. (2016). Prevention of recurrent gout: Pharmacologic urate-lowering therapy and treatment of tophi. Retrieved on 5/14/2016 at: www.uptodate.com/contents/search?search=Prevention+of+recurrent+gout%3A+Pharmacologic+urate-lowering+therapy+and+%09treatment+of+tophi&x=4&y=9

Bultink, I. E. (2012). Osteoporosis and fractures in systemic lupus erythematosus. Arthritis Care and Research, 64(1), 2–8.

Centers for Disease Control and Prevention (CDC). (2015). *Osteoarthritis (OA)*. Retrieved on 5/14/2016 at: www.cdc.gov.

Centers for Disease Control and Prevention (CDC). (2015a). *Systemic lupus erythematous (SLE or lupus): Prevalence and incidence*. Retrieved on 5/14/2016 at: www.cdc.gov/arthritis/basics/lupus.htm

Centers for Disease Control and Prevention (CDC). (2015b). *Gout*. Retrieved on 5/14/2016 at: www.cdc.gov/arthritis/basics/gout.htm

Centers for Disease Control and Prevention (CDC). (2015c). *Fibromyalgia*. Retrieved on 5/14/2016 at: www.cdc.gov/arthritis/basics/fibromyalgia.htm

Chasset, F., Frances, C., Barete, S., et al. (2015). Influence of smoking on the efficacy of antimalarials in cutaneous lupus: A meta-analysis of the literature. Journal of the American Academy of Dermatology, 72(4), 634–639

Chopra, A. (2015). Disease burden of rheumatic diseases in India CAPCORD perspective. Indian Journal of Rheumatology, 10, 70-77.

Chopra, A., Ghorpade, R., Sarmukkadam, S., Joshi, V. L., Mathews, A. L., Gowri, L. & Rahim, A et al., (2012). 5 Million Patients and Not 0.34% Is Worrisome: Burden of Rheumatoid Arthritis in India Based On a Bone and Joint Decade India Community Oriented Program for Control of Rheumatic Disease. American College of Rheumatology, Meeting abstract 58, 2012.

*Cottrell, J. D., Jonas, M., Bergsten, U., et al. (2013). The nurse's role in addressing unmet treatment and management needs of patients with rheumatoid arthritis: Delphi-based recommendations. International Journal of Nursing Knowledge, 24(2), 66–76.

Dewing, K. A. (2015). Management of patients with psoriatic arthritis. The Nurse Practitioner, 40(4), 40–46.

Di Lorenzo, A. L. (2015). *HLA-B27 syndromes*. Retrieved on 5/14/2016 at: www.emedicine.medscape.come/article/1201027-overview

Dogra, S., & Yadav. S. (2010). Psoriasis in India: Prevalence and pattern. Indian Journal of Dermatology Venereology Leprology, 76, 595–601.

Fonseca, R., Bernardes, M., Terroso, G., et al. (2014). *Silent burdens in disease: Fatigue and depression in SLE*. Autoimmune Diseases, 2014, 790724.

Fujita, T., Kutsumi, H., Sanuki, T., et al. (2013). Adherence to the preventive strategies for nonsteroidal anti-inflammatory drug-or low–dose aspirin-induced gastrointestinal injuries. Journal of Gastroenterology, 48(5), 559–573.

**Hochberg, C. (1997). Updating the American College of Rheumatology revised criteria for the classification of systemic lupus erythematosus. Arthritis and Rheumatism, 40(9), 1725.

Jordan, S., Maurer, B., Toniolo, M., et al. (2015). Performance of the new ACR/EULAR classification criteria for systemic sclerosis in clinical practice. Rheumatology, 54(8), 1454–1458.

Kalunian, K. C. (2015a). *Nonpharmacologic therapy of osteoarthritis*. Retrieved on 5/15/2016 at: www.uptodate.com/contents/search?search=Nonpharmacologic+therapy+of+osteoarthritis+&x=13&y=8

Kalunian, K. C. (2015b). Treatment of osteoarthritis resistant to initial pharmacologic therapy. Retrieved on 5/15/2016 at: www.uptodate.com/contents/search?search=Treatment+of+osteoarthritis+resistant+to+initial+pharmacologic+therapy&x=8&y=16

Lim, S., Bayakly, A. R., Helmick, C. G., et al. (2014). The incidence and prevalence of systemic lupus erythematosus, 2002–2004. Arthritis & Rheumatology, 66(2), 357–368. Marcus, D. M. (2015). *Herbal remedies, supplements & acuncture for arthritis*. The American College of Rheumatology. Retrieved on 5/14/2016 at: www.rheumatology.org/i-am-a/patient-caregiver/treatments/herbal-remedies-supplements-acupuncture-for-arthritis.

Martin, G. M., Thornhill, T. S., & Katz, J.M. (2015). Total knee arthroplasty. Retrieved on 5/14/2016 at: www.uptodate.com/contents/search?search=Total+knee+arthroplastypolimiosite&x=16&y=10

Martin, M. S., Van Sell, S., &Danter, J. (2012). Glucosamine and chondroitin: An appropriate adjunct treatment of symptomatic osteoarthritis of the knee. Orthopaedic Nursing, 31(3), 160–166.

Miller, M. L., & Viegels, R. A. (2016). *Clinical manifestations of dermatomyositis and polymyositis in adults*. Retrieved on 5/14/2016 at: www.uptodate.com/contents/clinical-manifestations-of-dermatomyositis-and-polymyositis-in-adults?source=machineLearning&search=polimiosite&selectedTitle=2%7E150&sectionRank=1&anchor=H17269403

Misra, R., Hissaria, P., Tandon V., Aggarwal, A., Kishnanai, N., Dabadghao. (2003). Primary Sjogern Syndrome: Rarity in India. Journal of Physicians of India, 51, 859–862.

Moerman, R., Bootsma, H., Kroese, R., et al. (2013). Sjogren's syndrome in older patients: Aetiology, diagnosis and management. Drugs and Aging, 30(3), 137–153.

Montes, R. A., Mocarzel, L.O., Lanzieri, P. G., et al. (2016). Smoking and its association with morbidity in systemic lupus erythematosus. Arthritis and Rheumatology, 68(2), 441–448.

Neoai, T., Jansen, T. A., Dalbeth, N., et al. (2015). 2105 Gout classification criteria: An American College of Rheumatology collaborative project. Retreived on 8/25/2016 at: www.rheumatology.org/Practice-Quality/Clinical-Support/Criteria.

Palmer, D., & El Miedany, Y. (2014). Rheumatoid arthritis: Recommendations for treat to target. British Journal of Nursing, 23(6), 310–315.

Prakash Pal, C., Singh, P., Chaturvedi, S., Pruthi, K. K & Vij, A (2016). Epidemiology of knee arthritis in India and related factors. Indian Journal of Orthopaedics, 50(5), 518–522.

Quemeneur, T., Mouthon, L., Cacoub, P., et al. (2013). Systemic vasculitis during the course of systemic sclerosis: Report of 12 cases and review of the literature. Medicine, 92(1), 1–9.

Ramos-Remus, C., Duran-Barragan, S., &Castillo-Ortiz, J. (2012). Beyond the joints: Neurological involvement in rheumatoid arthritis. Clinical Rheumatology, 31(1), 1–12.

Seetharaman, M. (2015). *Giant Cell Arteritis (Temporal Arteritis) workup*. Retrieved on 5/15/2016 at: emedicine.medscape.com/article/332483-workup

Sholter, D. E., & Russell, A. S. (2016). *Synovial fluid analysis*. Retrieved on 5/14/2016 at: www.uptodate.com/contents/synovial-fluid-analysis.

Schur, P. H., & Moreland, L. W. (2016). *General principles of management of rheumatoid arthritis in adults*. Retrieved on 5/14/2016 at: www.uptodate.com/contents/general-principles-of-management-of-rheumatoid-arthritis-in-adults?source=search_result&search=rheumatoid+arthritis&selectedTitle=3~150

Smith, W. M. (2013). Gender and spondyloarthropathy-associated uveitis. Journal of Opthalmology, 2013, 928264.

Tan, E. M., Cohen, A. S., Fries, J. F., et al. (1982). The 1982 revised criteria for the classification of systemic lupus erythematosus. Arthritis and Rheumatism, 25(11), 1271–1277.

Varga, J. (2014). *Diagnosis and differential diagnosis of systemic sclerosis (scleroderma) in adults*. Retrieved on 5/14/2016 at: www.uptodate.com/contents/search?search=Diagnosis+and+differential+diagnosis+of+systemic+sclerosis+%28scleroderma%29+in+%09adults&x=14&y=9

Varga, J., & Steen, V. (2015). Pulmonary arterial hypertension in systemic sclerosis (scleroderma): Definition, classification, risk factors, screening and prognosis. Retrieved on 5/14/2016 at: www.uptodate.com/contents/table-of-contents/rheumatology/scleroderma.

Yurdakul, F. G., Bodur, H., Sivas, F., et al. (2015). Clinical features, treatment and monitoring in patients with olymyalgiarheumatica. Archives of Rheumatology, 30(1), 28–33.

Resources

American College of Rheumatology and Association of Rheumatology Health Professionals, www.rheumatology.org
American Fibromyalgia Syndrome Association (AFSA), www.afsafund.org
Arthritis Foundation, www.arthritis.org
Centers for Disease Control and Prevention, www.cdc.gov
Indian Rheumatology Association, http://www.indianrheumatology.org/
Lupus Foundation of America, www.lupus.org
National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institutes of Health, www.niams.nih.gov
Scleroderma Foundation, www.scleroderma.org
Sjögren's Syndrome Foundation, www.sjogrens.org
Spondylitis Association of America, www.spondylitis.org

UNIT

XVIII Oncologic Nursing

Chapter 58 Management of Patients with Oncologic Disorders 1849

Chapter 59 Palliative Care and End-of-Life Care 1949

CHAPTER 58

Management of Patients with Oncologic Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1 Compare the function and behavior of normal and cancer cells.
2 Differentiate between the different malignant processes that occur in oncologic disorders.
3 Identify agents and factors that are carcinogenic.
4 Describe the role of nurses in health education and prevention of oncologic disorders.
5 Differentiate among the goals of cancer care: prevention, diagnosis, cure, control, and palliation.
6 Describe the roles of surgery, radiation therapy, chemotherapy, hematopoietic stem cell transplantation, hyperthermia, targeted therapy, and symptom management in treating cancer.
7 Use the nursing process as a framework for the care of patients with cancer.
8 Describe the etiopathophysiology, clinical manifestations, and collaborative management of selected cancers in females
9 Identify assessment parameters and nursing management of patients with oncologic emergencies.
10 Discuss the role of nurses in cancer survivorship care.

GLOSSARY

alopecia: hair loss
anaplasia: pattern of growth in which cells lack normal characteristics and differ in shape and organization with respect to their cells of origin; usually, anaplastic cells are malignant
angiogenesis: growth of new blood vessels that allow cancer cells to grow
apoptosis: a normal cell mechanism of programmed cell death
benign: not cancerous; benign tumors may grow but are unable to spread to other organs or body parts
brachytherapy: delivery of radiation therapy through internal implants placed inside or adjacent to the tumor
cancer: a group of disorders characterized by abnormal cell proliferation, in which cells ignore growth-regulating signals in the surrounding environment
carcinogenesis: process of transforming normal cells into malignant cells
carcinogens: chemicals, physical factors, and other agents that cause cancer
chemotherapy: the use of medications to kill tumor cells by interfering with cellular functions and reproduction
cytokines: substances produced primarily by cells of the immune system to enhance production and functioning of components of the immune system
extravasation: leakage of intravenous medication from the veins into the subcutaneous tissues
grading: identification of the type of tissue from which the tumor originated and the degree to which the tumor cells retain the functional and structural characteristics of the tissue of origin
graft-versus-host disease (GVHD): an immune response initiated by T lymphocytes of donor tissue against the recipient's tissues (skin, gastrointestinal tract, liver); an undesirable response
graft-versus-tumor effect: the donor immune cell response against the malignancy; a desirable response
malignant: having cells or processes that are characteristic of cancer
mammogram: screening test performed to identify breast cancer early in those who are at risk of developing breast cancer
metastasis: spread of cancer cells from the primary tumor to distant sites
mucositis: inflammation of the lining of the mouth, throat, and gastrointestinal tract often associated with cancer therapies
myelosuppression: suppression of the blood cell–producing function of the bone marrow
nadir: lowest point of white blood cell depression after therapy that has toxic effects on the bone marrow
neoplasia: uncontrolled cell growth that follows no physiologic demand; cancer
neutropenia: abnormally low absolute neutrophil count
oncology: field or study of cancer
palliation: relief of symptoms and promotion of comfort and quality of life regardless of the disease stage
PAP smear test: Papanicolaou smear test, a screening test to identify the cancer cervix at early stage
precision medicine: using advances in research, technology, and policies to develop individualized plans of care to prevent and treat disease
radiation therapy: the use of ionizing radiation to kill malignant cells
staging: process of determining the extent of disease, including tumor size and spread or metastasis to distant sites
stomatitis: inflammation of the oral tissues, often associated with some chemotherapeutic agents and radiation therapy to the head and neck region
targeted therapies: cancer treatments that seek to minimize the negative effects on healthy tissues by disrupting specific cancer cell functions (such as malignant transformation), metabolism, communication pathways, processes for growth and metastasis, and genetic coding
thrombocytopenia: decrease in the number of circulating platelets; associated with the potential for bleeding
vesicant: substance that can cause inflammation, damage, and necrosis with extravasation from blood vessels and contact with tissues

Introduction

Cancer is a large group of disorders with different causes, manifestations, treatments, and prognoses. Because cancer can involve any organ system and treatment approaches have the potential for multisystem effects, cancer nursing practice overlaps with numerous nursing specialties. Cancer nursing practice covers all age groups and is carried out in various settings, including acute care institutions, outpatient centers, physician offices, rehabilitation facilities, the home, and long-term care facilities. The scope, responsibilities, and goals of cancer nursing, also called oncology nursing, are as diverse and complex as those of any nursing specialty. Nursing management of the patient with oncologic disorders includes care of patients throughout the cancer trajectory from prevention through end-of-life care (see Fig. 58-1).

Precision medicine is now possible because of the recent development of biologic databases (e.g., human genome sequencing), technological advances that can identify unique characteristics of individual persons (e.g., genomics, cellular assay tests), and computer-driven systems that can mine and analyze datasets. This is an exciting time for oncology as the immediate goal of the precision medicine initiative is to focus on preventing and curing cancers (Collins & Varmus, 2015).

Epidemiology

In 2015, nearly 700,000 new cancer cases were diagnosed. In the same year, nearly 600,000 Americans died as a result of cancer. Despite significant advances in science and technology, cancer is the second leading cause of death in the United States (Siegel, Miller, & Jemal, 2015). Currently, one in four deaths is caused by cancer. The leading causes of cancer death in the United States in order of frequency and location are lung, prostate, and colorectal cancer in men and lung, breast, and colorectal cancer in women. Most cancer occurs in older adults; according to the American Cancer Society (ACS), 78% of all cancer diagnoses are in people 55 years of age or older (2015a). Overall, the incidence of cancer is higher in men than in women.

Although the overall rate of cancer deaths has declined, cancer death rates in African American men remain substantially higher than those among Caucasian men and two times those of Hispanic men (Siegel et al., 2015). While African American women have a lower risk of cancer overall than white women, they have 14% higher death rates for all cancers compared with white women and women in general (ACS, 2016a). Racial disparities may be attributed to the burdens of comorbid conditions, such as cardiovascular disease, and poverty experienced more often in the African American population than in others (ACS, 2016a); (DeNavas-Walt, Proctor, & Smith, 2013).

Cancer incidence and death rates also vary by geography. In states where the prevalence of tobacco use is high, the incidence of lung cancer tends to be greater than in states where smoking is not as common. In locations where there is greater socioeconomic disparity, the incidence of advanced cancer and overall cancer death rates are higher than in regions where there is not such disparity (Kohler, Sherman, Howlader, et al., 2015).

According to the Indian Council of Medical Research (ICMR), India is likely to have 17.3 lakh new cases of cancer and over 8.8 lakh deaths due to cancer by 2020 with cancers of breast, lungs, and cervix topping the list.

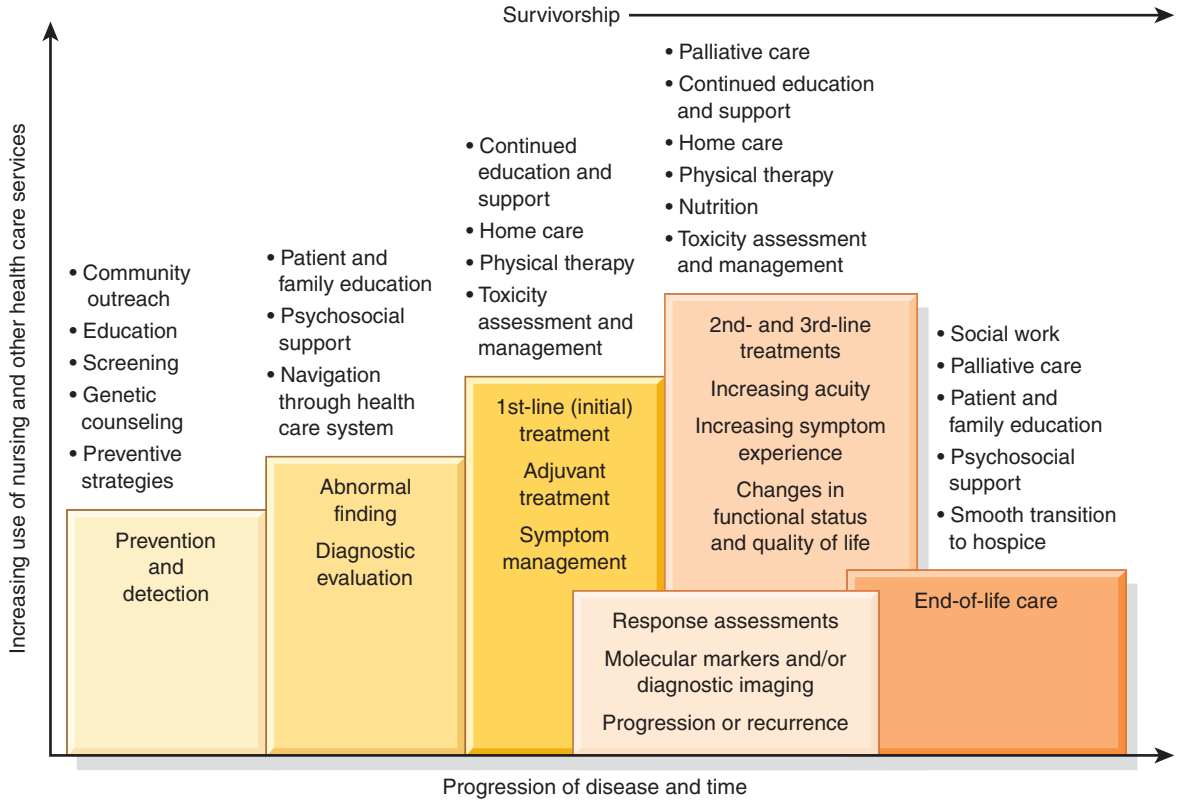


Figure 58-1 • Cancer care trajectory. The cancer care trajectory reflects the phases and care required during the continuum of the cancer experience from prevention and early detection through end-of-life care. Specialized nursing care is provided throughout the entire trajectory.

TABLE 58-1 Regional Distribution and Causes of Cancer in India

Region	Type of Cancer	Possible Cause
Northeast region (highest cancer rate)	Esophagus cancer	Tobacco, household burning of firewood
West Bengal	Lung, urinary bladder cancer	Air and water pollution
South and coastal India	Stomach cancer	Diet rich in spices and salt
Goa	Colon cancer	Red meat, alcohol, and tobacco
Gujarat and Rajasthan	Head and neck cancer	Tobacco and pan masala
Punjab (Malwa Belt)	All cancers higher than average, especially, kidney, urinary bladder, and breast cancer	Pollution, pesticides, and toxins in food

Adopted from National Registry Cancer Program, ICMR report, 2015.

According to the World Health Organization cancer report, the number of cancer cases in India is increasing every year. Cancer can affect almost any part of the body. National Cancer Registry reported that the cancer of lungs, oral cavity, lip, throat, and neck in males and cancer of breast, cervix, and ovary in females account for over 50% of all cancer deaths in India.

The Northeast region in India reported the highest number of cancer cases in both males and females. Aizawl district in Mizoram reported the highest number of cases among males while Papum Pare district in Arunachal Pradesh recorded the highest number of cases among females (ICMR, 2016).

Geographical Distribution of Cancer in India

There are various internal and external factors affecting regional variation in cancer incidence and mortality. Internal factors include genetic, hormonal, and poor immune conditions while external or environmental factors include food habits, industrialization, pollution, and lifestyle. India's most populous state, Uttar Pradesh, is estimated to have the maximum number of cancer cases and cancer mortality rates followed by Maharashtra and Bihar (Parihar, 2015).

Table 58-1 lists cancer-affected geographical regions in India with their possible causes.

Pathophysiology of the Malignant Process

Cancer is a disease process that begins when a cell is transformed by genetic mutations of the cellular deoxyribonucleic acid (DNA). Genetic mutations may be inherited and/or acquired, leading to abnormal cell behavior (Grossman & Porth, 2014). The initial genetically altered cell forms a clone and begins to proliferate abnormally, evading normal intracellular and extracellular growth-regulating processes or signals as well as the immune system defense mechanisms of the body. Genetic mutations may lead to abnormalities in cell signaling transduction processes (signals from outside and within cells that turn cell activities either on or off) that can in turn lead to cancer development. Ultimately cells acquire a variety of capabilities that allow them to invade surrounding tissues and/or gain access to lymph and blood vessels, which carry the cells to other areas of the body resulting in metastasis or spread of the cancer (Acharyya, Matrisian, Welch, et al., 2015). Pathophysiology of a malignant process is presented in Figure 58-2.

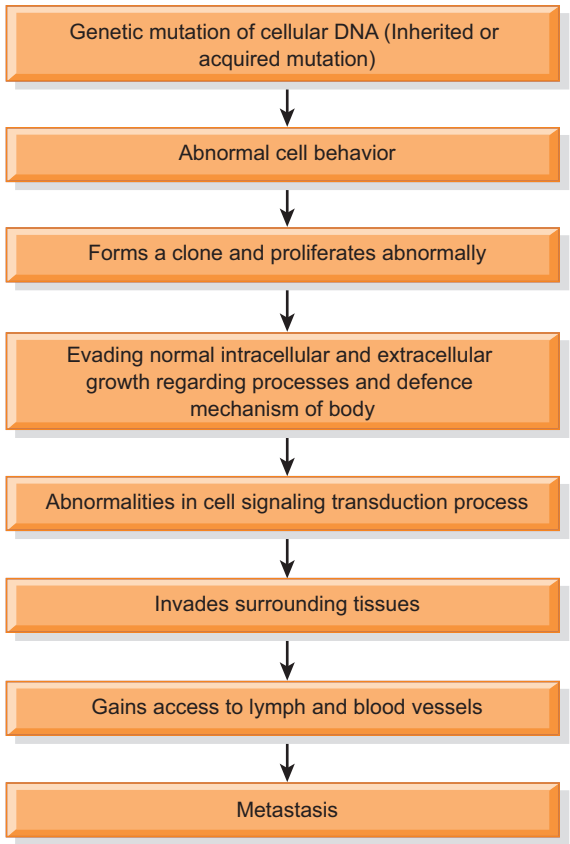


Figure 58-2 • Pathophysiology of a malignant process. *Signaling transduction process*: It is by which a cell converts an extracellular signal into a response. It plays an important role in activity, cellular function, cellular differentiation, and cell proliferation.

Characteristics of Malignant Cells

Benign and malignant cells differ in many cellular growth characteristics, including the method and rate of growth, ability to metastasize or spread, destruction of tissue, and ability to cause death. These differences are summarized in Table 58-2. The degree of anaplasia (a pattern of growth in which cells lack normal characteristics and differ in shape and organization with respect to their cells of origin) is associated with increased malignant potential.

Carcinogenesis

Molecular Process

Malignant transformation, or **carcinogenesis,** is thought to be at least a three-step cellular process, involving initiation, promotion, and progression. Agents that initiate or promote malignant transformation are referred to as **carcinogens**.

During *initiation,* carcinogens (substances that can cause cancer), such as chemicals, physical factors, or biologic agents,

TABLE 58-2 Characteristics of Benign and Malignant Tumors

Characteristics	Benign	Malignant
Cell	Well-differentiated cells resemble normal cells of the tissue from which the tumor originated.	Cells are undifferentiated and may bear little resemblance to the normal cells of the tissue from which they arose.
Mode of growth	Tumor grows by expansion and does not infiltrate the surrounding tissues; usually encapsulated.	Grows at the periphery and overcomes contact inhibition to invade and infiltrate surrounding tissues
Rate of growth	Rate of growth is usually slow.	Rate of growth is variable and depends on level of differentiation; the more anaplastic the tumor, the faster its growth.
Metastasis	Does not spread by metastasis	Gains access to the blood and lymphatic channels and metastasizes to other areas of the body or grows across body cavities such as the peritoneum
General effects	Is usually a localized phenomenon that does not cause generalized effects unless its location interferes with vital functions	Often causes generalized effects, such as anemia, weakness, systemic inflammation, weight loss, and CACS
Tissue destruction	Does not usually cause tissue damage unless its location interferes with blood flow	Often causes extensive tissue damage as the tumor outgrows its blood supply or encroaches on blood flow to the area; may also produce substances that cause cell damage
Ability to cause death	Does not usually cause death unless its location interferes with vital functions	Eventually causes death unless growth can be controlled

CACS, cancer-related anorexia-cachexia syndrome.

Adapted from Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

cause mutations in the cellular DNA. Normally, these alterations are reversed by DNA repair mechanisms or the changes initiate programmed cellular death (apoptosis) or cell senescence. Cells can escape these protective mechanisms with permanent cellular mutations occurring, but these mutations usually are not significant to cells until the second step of carcinogenesis.

During *promotion,* repeated exposure to promoting agents (co-carcinogens) causes proliferation and expansion of initiated cells with increased expression or manifestations of abnormal genetic information, even after long latency periods. Promoting agents are not mutagenic and do not need to interact with the DNA. Latency periods for the promotion of cellular mutations vary with the type of agent, the dosage of the promoter, and the innate characteristics and genetic stability of the target cell. The promotion phase generally leads to the formation of a preneoplastic or benign (noncancerous) lesion.

During *progression,* the altered cells exhibit increasingly malignant behavior. These cells acquire the ability to stimulate angiogenesis (growth of new blood vessels that allow cancer cells to grow), to invade adjacent tissues, and to metastasize. Cellular oncogenes are responsible for vital cell functions, including proliferation and differentiation. Cellular proto-oncogenes, such as those for the epidermal growth factor receptor (EGFR), transcription factors such as *c-Myc,* or cell signaling proteins such as *Kirsten ras* (*KRAS*), act as "on switches" for cellular growth. Amplification of proto-oncogenes or overexpression of growth factors, such as epidermal growth factor (EGF), can lead to uncontrolled cell proliferation. Mutations that increase the activity of oncogenes also deregulate cell proliferation. Genetic alterations in the gene for *KRAS* have been associated with pancreatic, lung, and colorectal cancers (http://www.mycancergenome.org/content/disease/lung-cancer/kras/ (Lovly, Horn, & Pao, 2015). Just as proto-oncogenes "turn on" cellular growth, cancer suppressor genes "turn off," or regulate, unneeded cellular proliferation. When suppressor genes are mutated, resulting in loss of function or expression, the cells begin to produce mutant cell populations that are different from their original cellular ancestors. See Chart 58-1 for further discussion of genetics concepts and cancer. A schematic representation of carcinogenesis may be perused from Figure 58-3.

Proliferative Patterns

During the lifespan, various body tissues normally undergo periods of rapid or proliferative growth that must be distinguished from malignant growth activity. Several patterns of cell growth exist: hyperplasia, dysplasia, and metaplasia. Cancerous cells, described as malignant neoplasms, demonstrate uncontrolled cell growth that follows no physiologic demand (neoplasia). Although both benign and malignant growths are classified and named by tissue of origin, the *International Classification of Diseases for Oncology* (Fritz, Percy, Jack, et al., 2013) is used by scientists and clinicians around the world as the nomenclature for malignant disease (see Table 58-3).

Etiology

Factors implicated or known to induce carcinogenesis include viruses and bacteria, physical agents, chemicals, genetic or familial factors, lifestyle factors, and hormones. Additional research is needed for a better understanding of the relationships between etiologic factors and cancer.

Viruses and Bacteria

It is estimated that about 11% of all cancers worldwide are linked to viral infections (Schiller & Lowy, 2014). After infecting individuals, DNA viruses insert a part of their own DNA near the infected cell genes causing cell division. The newly formed cells that now carry viral DNA lack normal controls on growth. Examples of these viruses that are known to cause cancer include human papillomavirus (HPV) (cervical and head and neck cancers), hepatitis B virus (HBV) (liver cancer), and Epstein-Barr virus (EBV) (Burkitt lymphoma and nasopharyngeal cancer) (Chen, Hsu, Yang, et al., 2014).

There is little evidence to support the link of most bacteria to cancer, although chronic inflammatory reactions to bacteria and the production of carcinogenic metabolites are possible mechanisms that continue to be investigated.

Chart 58-1 GENETICS IN NURSING PRACTICE

Genetics Concepts and Oncologic Disorders

Cancer is a genetic disease. Every phase of carcinogenesis is affected by multiple gene mutations. Some of these mutations are inherited (present in germ-line cells) and present a greater risk for a person to develop oncologic disorders; however, most (90%) are somatic mutations that are acquired mutations in specific cells. Examples of cancers influenced by genetics include:

Autosomal dominant:
- Breast and ovarian cancer
- Colorectal cancer
- Familial adenomatous polyposis
- Cowden syndrome
- Li-Fraumeni syndrome
- Lynch Syndrome (Hereditary nonpolyposis colon cancer)
- Multiple endocrine neoplasia types 1 and 2
- Neurofibromatosis types 1 and 2
- Prostate cancer
- Retinoblastoma
- Von Hippel–Lindau syndrome
- Wilm's tumor

Autosomal recessive:
- Ataxia telangiectasis
- Endometrial cancer
- Gastrointestinal stromal tumor
- Familial melanoma syndrome
- Xeroderma pigmentosum

Nursing Assessments

Refer to Chart 3-2: Genetics in Nursing Practice: Genetic Aspects of Health Assessment

Family History Assessment Specific to Oncologic Disorders
- Obtain information about both maternal and paternal sides of family for three generations.
- Obtain cancer history for at least three generations.
- Look for clustering of cancers that occur at young ages, multiple primary cancers in one individual, cancer in paired organs, and two or more close relatives with the same type of cancer suggestive of hereditary cancer syndromes.

Patient Assessment
- Assess for the following:
  - Physical findings that may predispose the patient to cancer, such as multiple colon polyps or the presence of more than one tumor. If a tumor was previously diagnosed, inquire about the age of the patient when the first tumor was noted.
  - Skin findings, such as atypical moles, that may be related to familial melanoma syndrome.
  - Multiple *café-au-lait* spots, axillary freckling, and two or more neurofibromas associated with neurofibromatosis type 1.
  - Facial trichilemmomas, mucosal papillomatosis, multinodular thyroid goiter or thyroid adenomas, macrocephaly, fibrocystic breasts, and other fibromas or lipomas related to Cowden syndrome.
- Assess for lifestyle risks (e.g., smoking, obesity, alcohol use).
- Determine potential occupational or environmental hazards that may generate exposure to inhaled chemicals, gases, or other irritants (e.g., toxic metals, asbestos, radon).

Management Issues Specific to Oncologic Disorders
- Assess patient's understanding of genetics factors related to their cancer.
- Offer appropriate genetics information and resources.
- Refer for cancer risk assessment when a hereditary cancer syndrome is suspected so that patient and family can discuss inheritance risk with other family members and availability of genetic testing.
- Provide support to patients and families with known genetic test results for hereditary cancer syndromes. Refer to support groups as appropriate.
- Participate in the management and coordination of risk reduction measures for those with known gene mutations.

Genetics Resources Specific to Oncologic Disorders

American Cancer Society: www.cancer.org
National Cancer Institute: www.cancer.gov
Indian Cancer Society, www.indiancancersociety.org

Helicobacter pylori is one bacterium identified as a significant cause of gastric cancer (Bessede, Dubus, Megraud, et al., 2014).

Physical Agents

Physical factors associated with carcinogenesis include exposure to sunlight, radiation, chronic irritation or inflammation, tobacco carcinogens, industrial chemicals and asbestos.

Excessive exposure to the ultraviolet rays of the sun, especially in fair-skinned people, increases the risk of skin cancers. Factors such as clothing styles (sleeveless shirts or shorts), the use of sunscreens, occupation, recreational habits, and environmental variables, including humidity, altitude, and latitude, all play a role in the amount of exposure to ultraviolet light.

Exposure to ionizing radiation can occur with repeated diagnostic x-ray procedures or with radiation therapy used to treat disease. Improved x-ray equipment minimizes the risk of extensive radiation exposure. Radiation therapy used in cancer treatment and exposure to radioactive materials at nuclear weapon manufacturing sites or nuclear power plants in the past have been associated with a higher incidence of leukemia, multiple myeloma, and cancers of the lung, bone, breast, thyroid, and other tissues. Background radiation from the natural decay processes that produce radon has also been associated with lung cancer. Ventilation is advised in homes with high levels of trapped radon to allow the gas to disperse into the atmosphere.

Chemical Agents

Many cancers are thought to be related to environmental factors (ACS, 2015a). Most hazardous chemicals produce their toxic effects by altering DNA structure. This can occur in body sites distant from that of initial chemical exposure.

Tobacco smoke, thought to be the single most lethal chemical carcinogen, accounts for about one third of cancer deaths (ACS, 2015a). Smoking is strongly associated with cancers of the lung, head and neck, esophagus, stomach, pancreas, cervix, kidney, and bladder and with acute myeloblastic leukemia (U.S. Department of Health and Human Services [HHS], 2014).

Passive smoke (i.e., secondhand smoke) has been linked to lung cancer; nonsmokers who live with a smoker have about a 20% to 30% greater risk of developing lung cancer (HHS, 2014). There is evidence that passive smoke may be linked with childhood leukemia and cancers of the larynx, pharynx, brain, bladder, rectum, stomach, and breast (HHS, 2014).

Other combustible forms of tobacco such as cigars, pipes, roll-your-own products, and water pipes (or hookah) are also associated with increased cancer risk (ACS, 2015a). Electronic

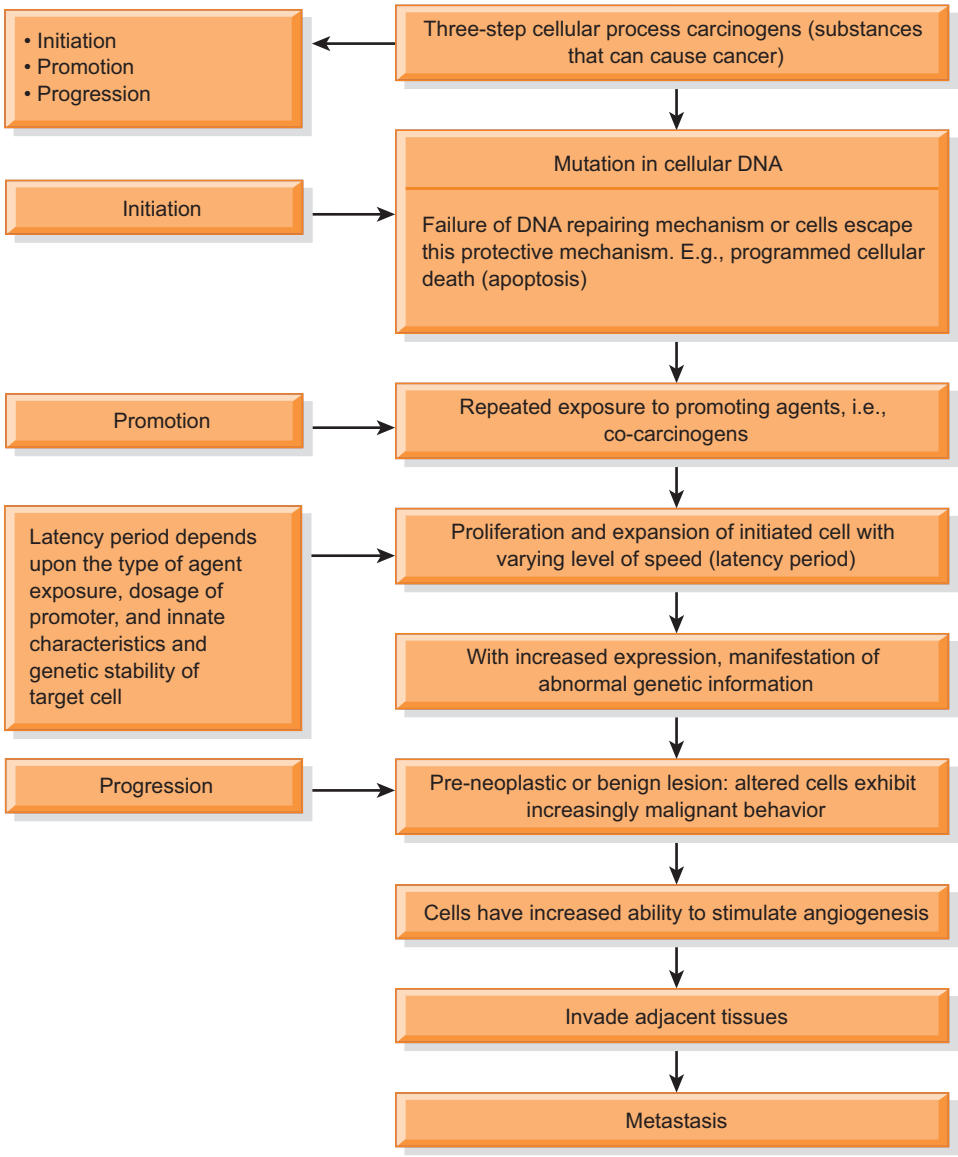


Figure 58-3 • Schematic presentation of carcinogenesis.

nicotine delivery systems referred to as electronic cigarettes have gained increased popularity as an alternative to tobacco. Although there are no data regarding the safety of these products, there is great concern about potential negative health effects.

Smokeless tobacco products, such as chewing tobacco and snuff, used most often by young adults aged 18 to 24 years, are associated with an increased risk of oral, pancreatic, and esophageal cancer (ACS, 2015a).

Many chemical substances found in the workplace are carcinogens or co-carcinogens. In the United States, carcinogens are classified by two federal agencies: the National Toxicology Program of the Department of Health and Human Services (HHS) and the Environmental Protection Agency's (EPA) Integrated Risk Information System (IRIS). The Centers for Disease Control and Prevention (CDC) established the National Institute for Occupational Safety and Health (NIOSH) to provide occupational exposure limits and guidelines for protection of the workforce as regulated by the Occupational Safety and Health Act of 1970. The extensive list of suspected chemical substances continues to grow and includes aromatic amines and aniline dyes; pesticides and formaldehydes; arsenic, soot, and tars; asbestos; benzene; cadmium; chromium compounds; nickel and zinc ores; wood dust; beryllium compounds; and polyvinyl chloride. Betel nut and lime, which are chewed as stimulants in some cultures, are also included.

Genetics and Familial Factors

Almost every cancer type has been shown to run in families. This may be due to genetics, shared environments, cultural or lifestyle factors. Genetic factors play a fundamental role in cancer cell development. Cancer has been associated with extra chromosomes, too few chromosomes, or translocated chromosomes. Cancers with these underlying genetic abnormalities include chronic myelogenous leukemia, meningiomas, acute leukemia, retinoblastomas, and Wilms tumor. In addition, certain syndromes represent a cluster of cancers identified by a specific genetic alteration that is inherited across generations. In these families, the associated genetic mutation is found in all cells (it is germline and somatic) and represents an inherited susceptibility to cancer for all family members who carry the mutation.

TABLE 58-3 Classification of Cancer by Tissue of Origin

Classification	Tissue of Origin	Characteristics	Term	Examples
Carcinoma	Epithelial	Account for 80–90% of all cancers		
	• Glandular epithelium	Organs or glands capable of secretion	Adenocarcinoma	Adenocarcinoma of the breast, lung, prostate
	• Squamous epithelium	Covers or lines all external and internal body surfaces	Squamous cell carcinoma	Squamous cell cancer of the skin, lung, esophagus
Sarcoma	Connective or Supportive			
	• Bone	Most common form of cancer of the bone	Osteosarcoma	Osteosarcoma of the femur, humerus
	• Cartilage	Rare, arises from within bones	Chondrosarcoma	Chondrosarcoma of the femur, pelvis
	• Adipose	Arises from deep soft tissue	Liposarcoma	Liposarcoma of the retroperitoneum, thigh
	• Smooth muscle	Very rare	Leiomyosarcoma	Leiomyosarcoma of the uterus, intestines, stomach
	• Skeletal muscle	Most common in young children	Rhabdosarcoma	Rhabdosarcoma of the head and neck, limbs
	• Fibrous tissue	Often involves long or flat bones	Fibrosarcoma	Fibrosarcoma of the femur, tibia, mandible
	• Membranes lining body cavities	Most often related to asbestos exposure	Mesothelial sarcoma or mesothelioma	Mesothelioma of the pleura or peritoneum
	• Blood vessels	With liver involvement may be related to occupational exposure to vinyl chloride monomer	Angiosarcoma	Angiosarcoma of the liver, heart
Myeloma	Plasma cells	Produced by B-cell lymphocytes; plasma cells produce antibodies	Not applicable (N/A)	N/A
Lymphoma	Lymphocytes	Two main classifications; may involve lymph nodes and/or body organs	Non-Hodgkin lymphoma	B-cell lymphoma, T-cell lymphoma
			Hodgkin lymphoma	N/A
Leukemia	Hematopoietic cells in the bone marrow	May involve various cell lines produced in the bone marrow		
	• White blood cells (WBCs)	N/A	Myelogenous	Acute myelogenous leukemia
	• Lymphocytes	N/A	Lymphocytic	Acute lymphocytic leukemia
	• Red blood cells (RBCs)	Involves overproduction of RBCs and is associated with increased levels of WBCs and platelets; also risk of additional bone marrow disease	Erythremia	Polycythemia vera

Adapted from Fritz, A., Percy, C., Jack, A., et al. (2013). World Health Organization. (2013). International classification of diseases for oncology (ICD-O)–3rd edition, 1st revision. Retrieved on 2/25/2016 at: apps.who.int/iris/bitstream/10665/96612/1/9789241548496_eng.pdf?ua=1

Approximately 5% to 10% of cancers in adults display a pattern of cancers suggestive of a familial predisposition (NCI, 2016). The hallmarks of families with a hereditary cancer syndrome include cancer in two or more first-degree relatives (the parent, sibling, or child of an individual), onset of cancer in family members younger than 50 years, the same type of cancer in several family members, individual family members with more than one type of cancer, and a rare cancer in one or more family members (NCI, 2016). There is also evidence of an autosomal dominant inheritance pattern of cancers affecting several generations of a family.

There have been considerable advances in the recognition of inherited cancer susceptibility syndromes and in the ability to isolate and identify the inherited genetic mutations responsible for cancer. These advances have enabled the appropriate identification of families at risk for certain syndromes. Examples include hereditary breast and ovarian cancer syndrome (*BRCA1* and *BRCA2*) and multiple endocrine neoplasia syndrome (*MEN1* and *MEN2*) (see Chart 58-1). Other cancers associated with familial inheritance syndromes include nephroblastomas, pheochromocytomas, and colorectal, stomach, thyroid, renal, prostate, and lung cancers (NCI, 2016).

Life Style Factors

Around one-third of the cancer deaths are due to the 5 leading behavioral and dietary risks: high body mass index, low fruit and vegetable intake, lack of physical activity, tobacco use, and alcohol use. These factors are second only to tobacco use as major risk factors associated with cancer development (ACS, 2015a).

The risk of cancer increases with long-term ingestion of carcinogens or co-carcinogens or the absence of protective substances in the diet. Dietary substances that appear to

increase the risk of cancer include fats, alcohol, salt-cured or smoked meats, nitrate- and nitrite-containing foods, and red and processed meats. Heavy alcohol use increases the risk of cancers of the mouth, pharynx, larynx, esophagus, liver, colon, rectum, and breast (ACS, 2015a).

Poor diet and obesity have been identified as contributing factors to the development of cancers of the breast (in postmenopausal women), colon, endometrium, esophagus, and kidney. Obesity is also associated with an increased risk for cancers of the pancreas, gallbladder, thyroid, ovary, and cervix, and for multiple myeloma, Hodgkin lymphoma, and an aggressive form of prostate cancer. Multiple studies have long linked sedentary lifestyles and lack of regular exercise to cancer development (Lu, Clague, & Bernstein, 2015); (Thomson, McCullough, Wertheim, et al., 2014).

Hormonal Agents

Tumor growth may be promoted by disturbances in hormonal balance, either by the body's own (endogenous) hormone production or by administration of exogenous hormones. Cancers of the breast, prostate, and uterus are thought to depend on endogenous hormonal levels for growth. Prenatal exposure to diethylstilbestrol (a synthetic form of the female hormone estrogen) has long been recognized as a risk factor for clear cell adenocarcinoma of the lower genital tract.

Hormonal changes related to the female reproductive cycle are also associated with cancer incidence. Early onset of menses before age 12 and delayed onset of menopause after age 55, null parity (never giving birth), and delayed childbirth after age 30 are all associated with an increased risk of breast cancer. Increased numbers of pregnancies are associated with a decreased incidence of breast, endometrial, and ovarian cancers.

Women who take estrogen after menopause appear to have an increased risk of ovarian cancer. Combination estrogen and progesterone therapy is linked to a higher risk of breast cancer. The longer the combined therapy is used, the higher the risk. However, within 3 years of stopping the hormones, the risk returns to that of a woman who never used this therapy. Women who have taken hormonal therapy appear to have a lower risk of getting colorectal cancer, but when cancers are found it may be more advanced (more likely to have spread to lymph nodes or distant sites) than the cancers found in women not taking hormones (ACS, 2015b).

Role of the Immune System

In humans, transformed cells arise on a regular basis, but are recognized by surveillance cells of the immune system that destroy them before cell growth becomes uncontrolled (immune surveillance). When the immune system fails to identify and stop the growth of transformed cells, a tumor can develop and progress.

Patients who are immunocompromised have an increased incidence of cancer. Transplant recipients who receive immunosuppressive therapy to prevent rejection of the transplanted organ have an increased incidence of cancer (Grossman & Porth, 2014). Patients with acquired immune deficiency syndrome (AIDS) have an increased incidence of Kaposi sarcoma and other cancers. Patients who were previously treated for one cancer are at increased risk for secondary cancers (Grossman & Porth, 2014).

Normal Immune Responses

Through the process of immune surveillance, an intact immune system usually has the ability to recognize and combat cancer cells through multiple, interacting cells and actions of the innate, humoral, and cellular components of the immune system. Tumor-associated antigens (TAAs; also called *tumor cell antigens*) are found on the membranes of many cancer cells. TAAs are processed by antigen-presenting cells (APCs) (e.g., macrophages and dendritic cells [very specialized cells of the immune system] that present antigens to both T- and B lymphocytes) and are presented to T lymphocytes that recognize the antigen-bearing cells as foreign. Multiple TAAs have been identified—some are found in many types of cancer, some exist in the normal tissues of origin as well as the cancer cells, some exist in both normal and cancer cells but are overexpressed (exist in higher concentrations) in cancer cells, and others are very specific to certain cancer types (Kasper, Fauci, Hauser, et al., 2015).

In response to recognizing TAAs as foreign, T-cell lymphocytes release several cytokines that elicit various immune system actions, including (1) proliferation of cytotoxic (cell-killing) T lymphocytes capable of direct destruction of cancer cells, (2) induction of cancer cell apoptosis, and (3) recruitment of additional immune system cells (B-cell lymphocytes that produce antibodies, natural killer cells, and macrophages) that contribute to the destruction and degradation of cancer cells.

Immune System Evasion

Several theories postulate how malignant cells survive and proliferate, evading the elaborate immune system defense mechanisms (Grossman & Porth, 2014). If the body fails to recognize the TAAs on cancer cells or the function of the APCs is impaired, the immune response is not stimulated. Some cancer cells have been found to have altered cell membranes that interfere with APC binding and presentation to T lymphocytes. Tumors can also express molecules that induce T-lymphocyte anergy or tolerance such as PD-1 ligand. These molecules bind to PD-1 proteins on T lymphocytes and either block the killing of the tumor or induce cell death in the lymphocyte. In addition, cancer cells have been found to release cytokines that inhibit APCs as well as other cells of the immune system. When tumors do not possess TAAs that label them as foreign, the immune response is not alerted. This allows the tumor to grow too large to be managed by normal immune mechanisms.

The immunogenicity (immunologic appearance) of cancer cells can be altered through genetic mutations, allowing the cells to evade immune cell recognition. Conversely, mutations are the source for some TAAs. Tumor antigens may combine with the antibodies produced by the immune system and hide or disguise themselves from normal immune defense mechanisms. The tumor antigen–antibody complexes that evade recognition lead to a false message to decrease further production of antibodies as well as other immune system components.

Overexpression (abnormally high concentrations) of host suppressor T lymphocytes induced through the release of cytokines by malignant cells is thought to down-regulate the immune response, thus permitting uncontrolled cell growth (Kasper et al., 2015). Suppressor T lymphocytes normally assist in regulating lymphocyte production and diminishing immune responses (i.e., antibody production) when they are no longer required. Low levels of antibodies and high levels of suppressor cells have been found in patients with multiple myeloma, which is a cancer associated with hypogammaglobulinemia (low amounts of serum antibodies). Conversely, there is evidence that proliferation of helper T lymphocytes, which promote the immune response, is impaired by cytokines produced by cancer cells (Kasper et al., 2015). Without helper T lymphocytes,

the immune system response is limited and the cancer cells continue to proliferate. Understanding the role of the immune system and identification of the ways in which cancer evades the body's natural defenses provide the foundation for therapeutic approaches that seek to support and enhance the immune system's role in combating cancer (see Chapter 54).

Detection and Prevention of Cancer

Nurses in all settings play a key role in cancer detection and prevention. Primary, secondary, and tertiary prevention of cancer are all important.

Primary Prevention

Primary prevention is about reducing the risks of disease through health promotion and risk reduction strategies. Guidelines on nutrition and physical activity for cancer prevention can be found in Chart 58-2.

An example of primary prevention is the use of immunization to reduce the risk of cancer through prevention of infections associated with cancer. The HPV vaccine is recommended to prevent cervical and head and neck cancers (Chen et al., 2014). The vaccine to prevent HBV infection is recommended by the CDC (2015) to reduce the risk of hepatitis and subsequent development of liver cancer.

Secondary Prevention

Secondary prevention involves screening and early detection activities that seek to identify precancerous lesions and early-stage cancer in individuals who lack signs and symptoms of cancer. ACS screening is advocated for many types of cancer (See Table 58-4) (ACS, 2016b). Detection of cancer at an early stage may reduce costs, use of resources, and the morbidity associated with advanced stages of cancer and their associated complex treatment approaches. Many screening and detection programs target people who do not regularly practice health-promoting behaviors or lack access to health care. Nurses continue to develop community-based screening and detection programs that address barriers to health care or reflect the socioeconomic and cultural beliefs of the target population (Benito, Binefa, Lluch, et al., 2014); (Brittain & Murphy, 2015); (Shackelford, Weyhenmeyer, & Mabus, 2015).

The evolving understanding of the role of genetics in cancer cell development has contributed to prevention and screening efforts. Many centers offer cancer risk evaluation programs that provide interdisciplinary in-depth assessment, screening, education, and counseling as well as follow-up monitoring for people at high risk for cancer (National Comprehensive Cancer Network [NCCN] 2015a); (NCCN 2015b). The NCI provides guidance for cancer risk assessment, counseling, education, and genetic testing (NCI, 2016).

Tertiary Prevention

Tertiary prevention efforts focus on monitoring for and preventing recurrence of the primary cancer as well as screening for the development of second malignancies in cancer survivors. Survivors are assessed for the development of second malignancies such as lymphoma and leukemia, which have been associated with certain chemotherapy agents and the use of radiation therapy (ACS, 2014). Survivors may also develop second malignancies not related to treatment but genetic mutations related to inherited cancer syndromes, environmental exposures, and lifestyle factors.

Diagnosis of Cancer

A cancer diagnosis is based on assessment of physiologic and functional changes and results of the diagnostic evaluation.

Chart 58-2 HEALTH PROMOTION

American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention

Individual Choices

Achieve and Maintain a Healthy Weight Throughout Life

- Be as lean as possible throughout life without being underweight.
- Avoid excessive weight gain at all ages. For those who are currently overweight or obese, losing even a small amount of weight has health benefits and is a good place to start.
- Engage in regular physical activity and limit consumption of high-calorie foods and beverages as key strategies for maintaining a healthy weight.

Adopt a Physically Active Lifestyle

- Adults should engage in at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity each week, or an equivalent combination, preferably spread throughout the week.
- Children and adolescents should engage in at least 1 hour of moderate- or vigorous-intensity physical activity each day, with vigorous-intensity activity at least 3 days each week.
- Limit sedentary behavior such as sitting, lying down and watching television, and other forms of screen-based entertainment.
- Doing any intentional physical activity above usual activities, no matter what one's level of activity, can have many health benefits.

Consume a Healthy Diet, With an Emphasis on Plant Sources

- Choose foods and beverages in amounts that help achieve and maintain a healthy weight.
- Limit consumption of processed meat and red meats.
- Eat at least $2\frac{1}{2}$ cups of vegetables and fruits each day.
- Choose whole grains in preference to processed (refined) grains.

If You Drink Alcoholic Beverages, Limit Consumption

- Drink no more than one drink per day for women or two per day for men.

Community Action

Public, private, and community organizations should work collaboratively at national, state, and local levels to implement policy environmental changes that:

- Increase access to affordable, healthy foods in communities, worksites, and schools, and decrease access to and marketing of foods and beverages of low nutritional value, particularly to youth.
- Provide safe, enjoyable, and accessible environments for physical activity in schools and worksites, and for transportation and recreation in communities.

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TABLE 58-4 American Cancer Society Screening Guidelines for the Early Detection of Cancer in Average-Risk Asymptomatic People[a]

Cancer Site	Population	Test or Procedure	Recommendation
Breast	Women, ages 40–54	Mammography	Women should undergo regular screening mammography starting at age 45 years. Women ages 45–54 should be screened annually. Women should have the opportunity to begin annual screening between the ages of 40 and 44.
	Women age 55 and over	Mammography	Transition to biennial screening, or have the opportunity to continue annual screening. Continue screening as long as overall health is good and life expectancy is 10+ years.
Cervix	Women, ages 21–29	Pap test	Screening should be done every 3 years with conventional or liquid-based Pap tests. Screening should be done every 5 years with both the HPV test and the Pap test (preferred), or every 3 years with the Pap test alone (acceptable).
	Women ages 30–65	Pap test & HPV DNA test	Women ages 66+ who have had ≥3 consecutive negative Pap tests or ≥2 consecutive negative HPV and Pap tests within the past 10 years, with the most recent test occurring in the past 5 years should stop cervical cancer screening. Women who have had a total hysterectomy should stop cervical cancer screening.
	Women ages 66+	Pap test & HPV DNA test	
Colorectal[b]	Men and women, ages 50+	Guaiac-based fecal occult blood test (gFOBT) with at least 50% sensitivity or fecal immunochemical test (FIT) with at least 50% sensitivity, or	Annual testing of spontaneously passed stool specimens. Single stool testing during a clinician office visit is not recommended, nor are "throw in the toilet bowl" tests. In comparison with guaiac-based tests for the detection of occult blood, immunochemical tests are more patient-friendly and are likely to be equal or better in sensitivity and specificity. There is no justification for repeating FOBT in response to an initial positive finding.
		Stool DNA test, or	Every 3 years
		Flexible sigmoidoscopy (FSIG), or	Every 5 years. FSIG can be performed alone, or consideration can be given to combining FSIG performed every 5 years with a highly sensitive guaiac-based gFOBT or FIT performed annually.
		Double-contrast barium enema (DCBE), or	Every 5 years
		Colonoscopy, or	Every 10 years
		CT Colonography	Every 5 years
Endometrial	Women, at menopause	At the time of menopause, women at average risk should be informed about risks and symptoms of endometrial cancer and encouraged to report any unexpected bleeding or spotting to their physicians.	N/A
Lung	Current or former smokers (quit within past 15 years) ages 55–74 in good health with at least a 30 pack-year history	Low-dose helical CT (LDCT)	Clinicians with access to high-volume, high-quality lung cancer screening and treatment centers should initiate a discussion about lung cancer screening with apparently healthy patients aged 55–74 who have at least a 30 pack-year smoking history, and who currently smoke or have quit within the past 15 years. A process of informed and shared decision making with a clinician related to the potential benefits, limitations, and harms associated with screening for lung cancer with LDCT should occur before any decision is made to initiate lung cancer screening. Smoking cessation counseling remains a high priority for clinical attention in discussions with current smokers, who should be informed of their continuing risk of lung cancer. Screening should not be viewed as an alternative to smoking cessation.

(Continued)

(Continued)

Prostate	Men, age 50+	Digital rectal examination (DRE) and prostate-specific antigen (PSA) test	Men who have at least a 10-year life expectancy should have an opportunity to make an informed decision with their health care provider about whether to be screened for prostate cancer, after receiving information about the potential benefits, risks, and uncertainties associated with prostate cancer screening. Prostate cancer screening should not occur without an informed decision-making process.
Cancer-related checkup	Men and women, age 20+	On the occasion of a periodic health examination, the cancer-related checkup should include examination for cancers of the thyroid, testicles, ovaries, lymph nodes, oral cavity, and skin, as well as health counseling about tobacco, sun exposure, diet and nutrition, risk factors, sexual practices, and environmental and occupational exposures.	N/A

HPV, human papillomavirus; DNA, deoxyribonucleic acid; CT, computed tomography.

[a]All individuals should become familiar with the potential benefits, limitations, and harms associated with cancer screening.

[b]All positive tests (other than colonoscopy) should be followed up with colonoscopy.

Adapted with permission from American Cancer Society. Cancer Facts and Figures 2016. Atlanta: American Cancer Society, Inc.

Patients with suspected cancer undergo extensive testing to (1) determine the presence and extent of cancer, (2) identify possible disease metastasis, (3) evaluate the function of involved and uninvolved body systems and organs, and (4) obtain tissue and cells for analysis, including evaluation of tumor stage and grade. The diagnostic evaluation includes a review of systems; physical examination; imaging studies; laboratory tests of blood, urine, and other body fluids; procedures; and pathologic analysis. A selection of diagnostic tests is found in Table 58-5.

Patients undergoing extensive testing may be fearful of the procedures and anxious about possible test results. Nurses help address the patient's fear and anxiety by explaining the tests to be performed, the sensations likely to be experienced, and the patient's role in the test procedures. The nurse encourages the patient and family to voice their fears about the test results, supports the patient and family throughout the diagnostic evaluation, and reinforces and clarifies information conveyed by the physician. The nurse also encourages the patient and family to communicate, share their concerns, and discuss their questions and concerns with one another.

Tumor Staging and Grading

A complete diagnostic evaluation includes identifying the stage and grade of the tumor. This is accomplished prior to treatment to provide baseline data for evaluating outcomes of therapy and to maintain a systematic and consistent approach to ongoing diagnosis and treatment. Treatment options and prognosis are based on tumor stage and grade.

Staging provides a common language used by health care providers and scientists to accurately communicate about cancer across clinical settings and in research. These systems also provide a convenient shorthand notation that condenses lengthy descriptions into manageable terms for comparisons of treatments and prognoses.

Staging determines the size of the tumor, the existence of local invasion, lymph node involvement, and distant metastasis. Several systems exist for classifying the anatomic extent of disease. The tumor, nodes, and metastasis (TNM) system (see Chart 58-3) is one system used to describe many solid tumors (Acharyya et al., 2015); (ACS, 2015a).

Chart 58-3

TNM Classification System

T The extent of the primary tumor
N The absence or presence and extent of regional lymph node metastasis
M The absence or presence of distant metastasis
The use of numerical subsets of the TNM components indicates the progressive extent of the malignant disease.

Primary Tumor (T)

Tx Primary tumor cannot be assessed
T0 No evidence of primary tumor
Tis Carcinoma in situ
T1, T2, T3, T4 Increasing size and/or local extent of the primary tumor

Regional Lymph Nodes (N)

Nx Regional lymph nodes cannot be assessed
N0 No regional lymph node metastasis
N1, N2, N3 Increasing involvement of regional lymph nodes

Distant Metastasis (M)

Mx Distant metastasis cannot be assessed
M0 No distant metastasis
M1 Distant metastasis

Adapted from American Cancer Society (ACS). (2015a). Cancer facts and figures 2015. Retrieved on 2/22/2016 at: www.cancer.org/acs/groups/content/@editorial/documents/document/acspc-044552.pdf

Grading is the pathologic classification of tumor cells. Grading systems seek to define the type of tissue from which the tumor originated and the degree to which the tumor cells retain the functional and histologic characteristics of the tissue of origin (differentiation). Samples of cells used to establish the tumor grade may be obtained from tissue scrapings, body fluids, secretions, washings, biopsy, or surgical excision. This information helps providers predict the behavior and prognosis of various tumors. The grade corresponds with a numeric value ranging from I to IV. Grade I tumors, also known as well-differentiated tumors, closely resemble the tissue of origin

TABLE 58-5 Selected Diagnostic Tests Used to Detect Cancer

Test	Description	Examples of Diagnostic Uses
Tumor marker identification	Analysis of substances found in tumor tissue, blood, or other body fluids that are indicative of cancer cells or specific characteristics of cancer cells. These substances may also be found in some normal body tissues	Breast, colon, lung, ovarian, testicular, prostate cancers
Genetic tumor markers (Also called prognostic indicators)	Analysis for the presence of mutations (alterations) in genes found in tumors or body tissues. Assists in diagnosis, selection of treatment, prediction of response to therapy, and risk of progression or recurrence	Breast, lung, kidney, ovarian, brain cancers; leukemia; and lymphoma. Many uses of genetic profiling are considered investigational
Mammography	Use of x-ray images of the breast	Breast cancer
Magnetic resonance imaging (MRI)	Use of magnetic fields and radiofrequency signals to create sectioned images of various body structures	Neurologic, pelvic, abdominal, thoracic, breast cancers
Computed tomography (CT) scan	Use of narrow-beam x-ray to scan successive layers of tissue for a cross-sectional view	Neurologic, pelvic, skeletal, abdominal, thoracic cancers
Fluoroscopy	Use of x-rays that identify contrasts in body tissue densities; may involve the use of contrast agents	Skeletal, lung, gastrointestinal cancers
Ultrasonography (ultrasound)	High-frequency sound waves echoing off body tissues are converted electronically into images; used to assess tissues deep within the body	Abdominal and pelvic cancers
Endoscopy	Direct visualization of a body cavity or passageway by insertion of an endoscope into a body cavity or opening; allows tissue biopsy, fluid aspiration, and excision of small tumors. Used for diagnostic and therapeutic purposes	Bronchial, gastrointestinal cancers
Nuclear medicine imaging	Uses IV injection or ingestion of radioisotope substances followed by imaging of tissues that have concentrated the radioisotopes	Bone, liver, kidney, spleen, brain, thyroid cancers
Positron emission tomography (PET)	Through the use of a tracer, provides black-and-white or color-coded images of the biologic activity of a particular area, rather than its structure. Used in detection of cancer or its response to treatment	Lung, colon, liver, pancreatic, head and neck cancers; Hodgkin and non-Hodgkin lymphoma and melanoma
PET fusion	Use of a PET scanner and a CT scanner in one machine to provide an image combining anatomic detail, spatial resolution, and functional metabolic abnormalities	See PET
Radioimmunoconjugates	Monoclonal antibodies are labeled with a radioisotope and injected IV into the patient; the antibodies that aggregate at the tumor site are visualized with scanners	Colorectal, breast, ovarian, head and neck cancers; lymphoma and melanoma
Vascular imaging	Use of contrast agents that are injected into veins or arteries and monitored by fluoroscopy, CT, or MRI imaging in order to assess tumor vasculature. Used to assess tumor vascularity prior to surgical procedures. Use in assessing the efficacy of antiangiogenesis (preventing new blood vessel formation) drugs is largely investigational	Liver and brain cancers

in structure and function. Tumors that do not clearly resemble the tissue of origin in structure or function are described as poorly differentiated or undifferentiated and are assigned grade IV. These tumors tend to be more aggressive, less responsive to treatment, and associated with a poorer prognosis as compared to well-differentiated, grade I tumors. Various staging and grading systems are used to characterize cancers.

Anatomic Stage Group

Once the diagnosis, clinical stage, and histologic grade have been determined, the anatomic stage group, designated by I through IV (representing increasing severity of disease), is assigned to facilitate communication, treatment decisions, and estimation of prognosis. The anatomic stage group is also useful for comparing clinical outcomes.

Management of Cancer

Treatment options offered to patients with cancer are based on treatment goals for each specific type, stage, and grade of cancer. The range of possible treatment goals includes complete eradication of malignant disease (cure), prolonged survival and containment of cancer cell growth (control), or relief of symptoms associated with the disease and improvement of quality of life (palliation). Treatment approaches are not initiated until the diagnosis of cancer has been confirmed and staging and grading have been completed.

The health care team and the patient and family must have a clear understanding of the treatment options and goals. Open communication and support are vital as those involved periodically reassess treatment plans and goals when complications of therapy develop or disease progresses.

Multiple modalities are commonly used in cancer treatment. Various approaches, including surgery, radiation therapy, chemotherapy, hematopoietic stem cell transplantation (HSCT), hyperthermia, and targeted therapy, may be used together or at different times throughout treatment. Understanding the principles of each and how they interrelate is important in understanding the rationale and goals of treatment.

Surgery

Surgical removal of the entire cancer remains the ideal and most frequently used treatment method. However, the specific surgical approach may vary for several reasons. Diagnostic surgery is the definitive method for obtaining tissue to identify the cellular characteristics that influence all treatment decisions. Surgery may be the primary method of treatment, or it may be prophylactic, palliative, or reconstructive.

Diagnostic Surgery

Diagnostic surgery, or biopsy, is performed to obtain a tissue sample for histologic analysis of cells suspected to be malignant. In most instances, the biopsy is taken from the actual tumor; however, in some situations, it is necessary to take a sample of lymph nodes near a suspicious tumor. Many cancers can metastasize from the primary site to other areas of the body through the lymphatic circulation. Knowing whether adjacent lymph nodes contain tumor cells helps the health care team plan the best therapeutic approach to combat cancer that has spread beyond the primary tumor site. The use of injectable dyes and nuclear medicine imaging can help identify the sentinel lymph node or the initial lymph node to which the primary tumor and surrounding tissue drain. Sentinel lymph node biopsy (SLNB), also known as sentinel lymph node mapping, is a minimally invasive surgical approach that in many instances has replaced more invasive lymph node dissections (lymphadenectomy) and the associated complications such as lymphedema and delayed healing. SLNB has been widely adopted for regional lymph node staging in selected cases of melanoma and breast cancer (NCCN, 2015c).

Biopsy Types

Biopsy methods include excisional, incisional, and needle biopsy. The biopsy type is determined by the size and location of the tumor, the type of treatment anticipated if the cancer diagnosis is confirmed, and the need for surgery and general anesthesia. The biopsy method that allows for the least invasive approach while permitting the most representative tissue sample is chosen. Diagnostic imaging techniques can be used to assist in locating the suspicious lesion and to facilitate accurate tissue sampling. The patient and family are provided the opportunity and time to discuss the options before definitive plans are made.

Excisional biopsy is used for small, easily accessible tumors of the skin, upper or lower gastrointestinal and upper respiratory tracts. In many cases, the surgeon can remove the entire tumor as well as the surrounding marginal tissues. The removal of normal tissue beyond the tumor area decreases the possibility that residual microscopic malignant cells may lead to a recurrence of the tumor. This approach not only provides the pathologist with the entire tissue specimen for the determination of stage and grade but also decreases the chance of seeding tumor cells (disseminating cancer cells throughout surrounding tissues).

Incisional biopsy is performed if the tumor mass is too large to be removed. In this case, a wedge of tissue from the tumor is removed for analysis. The cells of the tissue wedge must be representative of the tumor mass so that the pathologist can provide an accurate diagnosis. If the specimen does not contain representative tissue and cells, negative biopsy results do not guarantee the absence of cancer.

Excisional and incisional approaches are often performed through endoscopy. However, a surgical procedure may be required to determine the anatomic extent or stage of the tumor. For example, a diagnostic or staging laparotomy (the surgical opening of the abdomen to assess malignant abdominal disease) may be necessary to assess malignancies such as gastric or colon cancer.

Needle biopsy is performed to sample suspicious masses that are easily and safely accessible, such as some masses in the breasts, thyroid, lung, liver, and kidney. Needle biopsies are most often performed on an outpatient basis. They are fast, relatively inexpensive, easy to perform, and may require only local anesthesia. In general, the patient experiences slight and temporary physical discomfort. In addition, the surrounding tissues are minimally disturbed, thus decreasing the likelihood of seeding cancer cells (disseminating cancer cells to adjacent tissue). Fine-needle aspiration (FNA) biopsy involves aspirating cells rather than intact tissue through a needle that is guided into a suspected diseased area. This type of specimen can only be analyzed by cytological examination (viewing only cells, not tissue). Often, x-ray, computed tomography (CT) scanning, ultrasonography, or magnetic resonance imaging (MRI) is used to help locate the suspicious area and guide placement of the needle. FNA does not always yield enough material to permit accurate diagnosis, necessitating additional biopsy procedures. A core needle biopsy uses a specially designed needle to obtain a small core of tissue that permits histologic analysis. Most often, this specimen is sufficient to permit accurate diagnosis.

Surgery as Primary Treatment

When surgery is the primary approach in treating cancer, the goal is to remove the entire tumor or as much as is feasible (a procedure sometimes called *debulking*) as well as any involved surrounding tissue, including regional lymph nodes.

Two common surgical approaches used for treating primary tumors are local and wide excisions. Local excision, often performed on an outpatient basis, is warranted when the mass is small. It includes removal of the mass and a small margin of normal tissue that is easily accessible. Wide or radical excisions (en bloc dissections) include removal of the primary tumor, lymph nodes, adjacent involved structures, and surrounding tissues that may be at high risk for tumor spread. This surgical method may result in disfigurement and altered functioning, necessitating rehabilitation, reconstructive procedures, or both. However, wide excisions are considered if the tumor can be removed completely and the chances of cure or control are good.

Minimally invasive surgical techniques are increasingly replacing traditional surgery associated with large incisions for a variety of cancers. The advantages of minimally invasive approaches include minimization of surgical trauma, decreased blood loss, decreased incidence of wound infection and other complications associated with surgery, decreased surgical time and requirement for anesthesia, decreased postoperative pain and limited mobility, and shorter periods of recovery (Nguyen, Summers, & Finkelstein, 2015).

Video-assisted endoscopic surgery, an example of minimally invasive surgery, uses an endoscope with intense lighting and an attached multichip mini-camera that is inserted into the

body through a small incision. The surgical instruments are inserted into the surgical field through one or two additional small incisions, each about 3 cm in length. The camera transmits the image of the involved area to a monitor so that the surgeon can manipulate the instruments to perform the necessary procedure. Such surgery is used for many thoracic and abdominal procedures. The use of robotics during laparoscopic procedures permits the removal of tumors with more precision and dexterity than could be accomplished by laparoscopic surgery alone (Niklas, Saar, Berg, et al., 2016). Laparoscopic robotic-assisted surgery has been used for prostate and gynecologic cancers. Transoral robotic-assisted surgery is being used for certain types of oral and laryngeal cancers (Chung, Rosenthal, Magnuson, et al., 2015).

Salvage surgery is an additional treatment option that uses an extensive surgical approach to treat the local recurrence of cancer after the use of a less extensive primary approach. Mastectomy to treat recurrent breast cancer after primary lumpectomy and radiation is an example of salvage surgery.

Surgery may completely excise limited areas of metastatic disease (referred to as oligometastatic disease) as well. An example would be colon cancer with one to three small areas of liver metastasis and no evidence of cancer elsewhere. In the past, patients with recurrent or metastatic disease were treated with palliation only as their disease was considered incurable. However, evidence suggests possible cure or prolonged disease-free survival for patients with controlled or completely removed primary cancer and completely removed, limited, metastatic disease (Corbin, Hellman, & Weichselbaum, 2013); (Di Lascio, & Pagani, 2014).

In addition to surgery that uses surgical blades or scalpels to excise the mass and surrounding tissues, several other types of techniques are available. Table 58-6 provides examples of these techniques.

A multidisciplinary approach to patient care is essential for the patient undergoing cancer-related surgery. The effects of surgery on the patient's body image, self-esteem, and functional abilities are addressed. If necessary, a plan for postoperative rehabilitation is made before the surgery is performed. The growth and dissemination of cancer cells may have produced distant micrometastases by the time the patient seeks treatment. Therefore, attempting to remove wide margins of tissue in the hope of "getting all the cancer" may not be feasible. This reality substantiates the need for a coordinated multidisciplinary approach to cancer therapy.

Once the surgery has been completed, one or more additional (or adjuvant) modalities may be chosen to increase the likelihood of eradicating the remaining microscopic cancer cells that are undetectable by available diagnostic procedures. However, some cancers that are treated surgically in the very early stages (e.g., skin and testicular cancers) are considered to be curable without additional therapy.

Prophylactic Surgery

Prophylactic or risk reduction surgery involves removing non-vital tissues or organs that are at increased risk of developing cancer. The following factors are considered when discussing possible prophylactic surgery:

- Family history and genetic predisposition
- Presence or absence of signs and symptoms
- Potential risks and benefits
- Ability to detect cancer at an early stage
- Alternative options for managing increased risk
- The patient's acceptance of the postoperative outcome

Colectomy, mastectomy, and oophorectomy are examples of prophylactic surgeries. Identification of genetic markers indicative of inherited cancer syndromes or a predisposition to develop some types of cancer plays a role in decisions concerning prophylactic surgeries. However, what is adequate justification for prophylactic surgery remains controversial. For example, several factors are considered when deciding to proceed with a prophylactic mastectomy, including a strong family history of breast cancer; positive *BRCA1* or *BRCA2* findings; an abnormal physical finding on breast examination, such as progressive nodularity and cystic disease; a proven history of breast cancer in the opposite breast; abnormal mammography findings; abnormal biopsy results; and individual factors that may influence the patient's decision-making process (Mahon, 2014). Prophylactic surgery is discussed with patients and families along with other approaches for managing increased risk of cancer development. Preoperative education and counseling, as well as long-term follow-up, are provided.

Palliative Surgery

When surgical cure is not possible, the goals of surgical interventions are to relieve symptoms, make the patient as

TABLE 58-6 Selected Techniques Used for Localized Destruction of Tumor Tissue

Type of Procedure	Description	Examples of Use
Chemosurgery	Use of chemicals or chemotherapy applied directly to tissue to cause destruction	Intraperitoneal chemotherapy for ovarian cancer involving the abdomen and peritoneum
Cryoablation	Use of liquid nitrogen or a very cold probe to freeze tissue and cause cell destruction	Cervical, prostate, and rectal cancers
Electrosurgery	Use of an electric current to destroy tumor cells	Basal and squamous cell skin cancers
Laser surgery	Use of light and energy aimed at an exact tissue location and depth to vaporize cancer cells (also referred to as photocoagulation or photoablation)	Dyspnea associated with endobronchial obstructions
Photodynamic therapy	IV administration of a light-sensitizing agent (hematoporphyrin derivative [HPD]) that is taken up by cancer cells, followed by exposure to laser light within 24–48 hours; causes cancer cell death	Palliative treatment of dysphagia associated with esophageal and dyspnea associated with endobronchial obstructions
Radiofrequency ablation (RFA)	Uses localized application of thermal energy that destroys cancer cells through heat: temperatures exceed 50°C (122°F)	Nonresectable liver tumors, pain control with bone metastasis

TABLE 58-7 Types of Palliative Surgery and Interventions

Procedure	Indications
Abdominal shunt placement	Ascites
Biliary stent placement	Biliary obstruction
Bone stabilization	Displaced bone fracture related to metastatic disease
Colostomy or ileostomy	Bowel obstruction
Cordotomy	Pain
Epidural catheter placement (for administering epidural analgesics)	Pain
Excision of solitary metastatic lesion	Metastatic lung, liver, or brain lesion
Gastrostomy, jejunostomy tube placement	Upper gastrointestinal tract obstruction
Hormone manipulation (removal of ovaries, testes, adrenals, pituitary)	Tumors that depend on hormones for growth
Nerve block	Pain
Percutaneous enteral gastrostomy (PEG) tube placement	Enteral nutrition
Pericardial drainage tube placement	Pericardial effusion
Peritoneal drainage tube placement	Ascites
Pleural drainage tube placement	Pleural effusion
Ureteral stent placement	Ureteral obstruction
Venous access device placement (for administering parenteral analgesics)	Pain

comfortable as possible, and promote quality of life as defined by the patient and family. Palliative surgery is performed in an attempt to relieve symptoms, such as ulceration, obstruction, hemorrhage, pain, and malignant effusions (see Table 58-7). Honest and informative communication with the patient and family about the goal of surgery is essential to avoid false hope and disappointment.

Reconstructive Surgery

Reconstructive surgery may follow curative or extensive surgery in an attempt to improve function or obtain a more desirable cosmetic effect. It may be performed in one operation or in stages. The surgeon who will perform the surgery discusses possible reconstructive surgical options with the patient before the primary surgery is performed. Reconstructive surgery may be indicated for breast, head and neck, and skin cancers.

The nurse assesses the patient's needs and the impact that altered functioning and body image may have on quality of life. Nurses provide patients and families with opportunities to discuss these issues. The individual needs of the patient undergoing reconstructive surgery and their families must be accurately recognized and addressed.

Nursing Management

Patients undergoing surgery for cancer require general perioperative nursing care (see Chapter 5). Surgical care is individualized according to age, organ impairment, specific deficits, comorbidities, cultural implications, and altered immunity. Combining other treatment methods, such as radiation and chemotherapy, with surgery also contributes to postoperative complications, such as infection, impaired wound healing, altered pulmonary or renal function, and the development of venous thromboembolism (VTE). The nurse completes a thorough preoperative assessment for factors that may affect the patient undergoing the surgical procedure.

Preoperatively, the nurse provides the patient and family with verbal and written information about the surgical procedure as well as other interventions that may take place intraoperatively (i.e., radiation implants). Instructions concerning prophylactic antibiotic requirements, diet, and bowel preparation are also provided.

Patients who are undergoing surgery for the diagnosis or treatment of cancer may be anxious about the surgical procedure, possible findings, postoperative limitations, changes in normal body functions, and prognosis. The patient and family require time and assistance to process this information, possible changes, and expected outcomes resulting from the surgery.

The nurse serves as the patient advocate and liaison and encourages the patient and family to take an active role in decision making when possible. If the patient or family asks about the results of diagnostic testing and surgical procedures, the nurse's response is guided by the information that was conveyed previously. The nurse may be asked to explain and clarify information for patients and families that was provided initially but was not grasped because of intense anxiety. It is important that the nurse, as well as other members of the health care team, provide information that is consistent.

Postoperatively, the nurse assesses patient responses to surgery and monitors the patient for possible complications, such as infection, bleeding, thrombophlebitis, wound dehiscence, fluid and electrolyte imbalance, and organ dysfunction. The nurse also provides for the patient's comfort. Postoperative education addresses wound care, pain management, activity, nutrition, and medication information.

Plans for discharge, follow-up, home care, and subsequent treatment and rehabilitation are initiated as early as possible to ensure continuity of care from hospital to home or from a cancer referral center to the patient's local hospital and health care provider. Patients and families are encouraged to use community resources such as the ACS for support and information (see the Resources section at the end of this chapter).

Radiation Therapy

Approximately 60% of patients with cancer receive radiation therapy at some point during treatment (Halperin, Wazer, Perez, et al., 2013). Radiation may be used to cure cancer, as in thyroid carcinomas, localized cancers of the head and neck, and cancers of the cervix. Radiation therapy may also be used to control cancer when a tumor cannot be removed surgically or when local nodal metastasis is present. Neoadjuvant (prior to local definitive treatment) radiation therapy, with or without chemotherapy, is used to reduce tumor size in order to facilitate surgical resection. Radiation therapy may be given prophylactically to prevent local recurrence or spread of microscopic cells from the primary tumor to a distant area (e.g., irradiating the breast and axilla following lumpectomy or mastectomy for breast cancer). Palliative radiation therapy is used to relieve the symptoms of locally advanced or metastatic disease, especially when the cancer has spread to the brain, bone, or soft tissue, or to treat oncologic emergencies, such as superior vena cava syndrome, bronchial airway obstruction, or spinal cord compression.

Two types of ionizing radiation—electromagnetic radiation (x-rays and gamma rays) and particulate radiation (electrons, beta particles, protons, neutrons, and alpha particles)—can be used to kill cells. The most lethal damage is the direct alteration of the DNA molecule within the cells of both malignant and normal tissues. Ionizing radiation can directly break the strands of the DNA helix, leading to cell death. It can also indirectly damage DNA through the formation of free radicals. If the DNA cannot be repaired, the cell may die immediately or may initiate apoptosis (Datta, Kundu, Ghosh, et al., 2014); (Montezano, Dulak-Lis, Tsiropoulou, et al., 2015).

Replicating cells are most vulnerable to the disruptive effects of radiation (during DNA synthesis and mitosis, i.e., early S, G_2, and M phases of the cell cycle; see Fig. 58-4). Therefore, those body tissues that undergo frequent cell division are most sensitive to radiation therapy. These tissues include bone marrow, lymphatic tissue, epithelium of the gastrointestinal tract, hair follicles, and gonads. Slower-growing tissues and tissues at rest (e.g., muscle, cartilage, nervous system, and connective tissues) are relatively radioresistant (less sensitive to the effects of radiation). However, it is important to remember that radiation therapy is localized treatment, and only the tissues that are within the treatment field are affected.

A radiosensitive tumor is one that can be destroyed by a dose of radiation that still allows for cell repair and regeneration in the surrounding normal tissue. If the radiation is delivered when most tumor cells are cycling through the cell cycle, the number of cancer cells destroyed (cell kill) is maximal. Radiation sensitivity is enhanced in tumors that are smaller in size and that contain cells that are rapidly dividing (highly proliferative) and poorly differentiated (no longer resembling the tissue of origin).

Radiation Dosage

The radiation dosage depends on the sensitivity of the target tissues to radiation, the size of the tumor, radiation tolerance of the surrounding normal tissues, and critical structures adjacent to the tumor target. The lethal tumor dose is defined as the dose that will eradicate 95% of the tumor yet preserve normal tissue. In external-beam radiation therapy (EBRT), the total radiation dose is delivered over several weeks in daily doses called *fractions*. This allows healthy tissue to repair and achieves greater cell kill by exposing more cells to the radiation as they begin active cell division. Repeated radiation treatments over time (fractionated doses) also allow for the periphery of the tumor to be reoxygenated repeatedly, because tumors shrink from the outside inward. This increases the radiosensitivity of the tumor, thereby increasing tumor cell death (Morgan, Ten Haken, & Lawrence, 2015). Newer approaches take advantage of increased radiation beam conformality (better tumor targeting) to administer radiation in fewer doses with larger fractions sizes (hypo-fractionation and stereotactic body radiotherapy [SBRT]).

Administration of Radiation

Radiation therapy can be given in various ways depending on the source of radiation used, the location of the tumor, and the type of cancer. The primary radiotherapy modalities include EBRT, brachytherapy (a form of internal radiation), systemic (radioisotopes), and contact or surface molds.

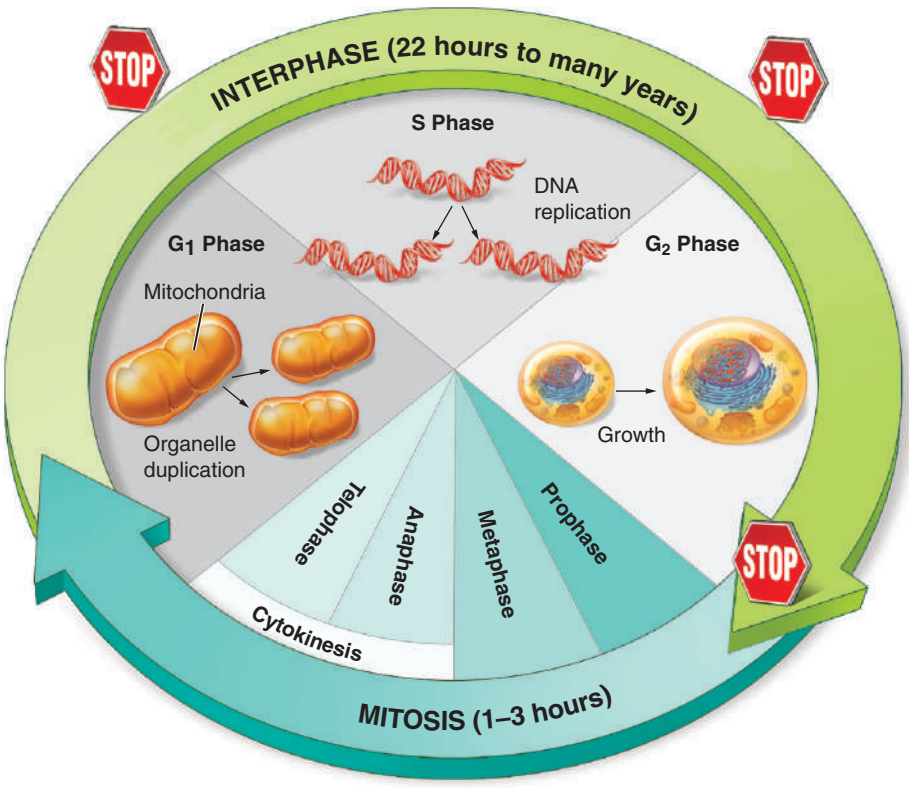


Figure 58-4 • Cell cycle. The cell cycle's four steps are illustrated beginning with G_1 and proceeding to M. The first growth phase (G_1), DNA synthesis phase (S), second growth phase (G_2), and mitosis (M) are illustrated. Reprinted with permission from Grossman, S. G., & Porth, C.M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

External Radiation

EBRT is the most commonly used form of radiation therapy. The energy utilized in EBRT is generated either from a linear accelerator or from a unit that generates energy directly from a core source of radioactive material such as a GammaKnife™ unit. Through computerized software programs, both approaches are able to shape an invisible beam of highly charged photons or gamma rays to penetrate the body and target the tumor with pinpoint accuracy.

Advances in computer technology allow multiple imaging modalities (CT, MRI, and PET scans) to be used to provide three-dimensional images of the tumor, neighboring tissues at risk for microscopic spread, and surrounding normal tissues or organs at risk for radiation-induced toxicity. These images, referred to as volumetric images, allow the radiation oncologist to plan for multiple radiation beams directed from different angles and different planes so that the beams conform precisely around the tumor (referred to as conformal radiation). The dose of radiation that reaches the surrounding normal tissues is reduced, leading to much less toxicity than in older forms of radiation therapy (Halperin et al., 2013). Treatment enhancements in EBRT include the ability to control different intensity or energy levels of radiation beams at different angles directed at the tumor, a process known as intensity-modulated radiation therapy (IMRT), which enables higher doses to be delivered to the tumor while sparing the important healthy structures surrounding the tumor (Halperin et al., 2013). IMRT can be given as standard daily fractions or as "hyperfractionated" twice-daily fractions, which shortens the duration of the patient's treatment schedule. Image-guided radiation therapy (IGRT) uses continuous monitoring of the tumor with ultrasound, x-ray, or CT scans during the treatment to allow for automatic adjustment of the beams as the tumor changes shape or position in an effort to spare the healthy surrounding tissue and reduce side effects. Additional treatment enhancements include respiratory gating, where the treatment delivery is actually synchronized with the patient's respiratory cycle, enabling the beam to be adjusted as the tumor or organ moves. These treatment advancements improve tumor destruction while reducing acute and long-term toxicities (Halperin et al., 2013).

Gamma rays generated from the spontaneous decay of naturally occurring solid source of radioactivity, such as cobalt-60, are one of the oldest forms of EBRT. With the advent of modern linear accelerators, the use of solid radioactive elements is confined primarily to the GammaKnife™ stereotactic radiosurgery unit, which is used as a one-time, high-dose delivery of EBRT for treatment of both benign and malignant intracranial lesions.

Stereotactic body radiotherapy (SBRT) is another form of EBRT that uses higher doses of radiation to penetrate very deeply into the body to control deep-seated tumors that cannot be treated by other approaches such as surgery. SBRT is delivered with considerably higher treatment fraction doses over a short span of time, usually 1 to 5 treatment days, in contrast to daily treatments for 5 days per week for 6 to 8 weeks for conventional EBRT. Specialized linear accelerators with the capability of robotically moving around the patient are used to deliver SBRT, such as the CyberKnife®, Trilogy™, and TomoTherapy® delivery systems, which are now more commonly available.

Proton therapy is another approach to EBRT. Proton therapy utilizes high linear energy transfer (LET) in the form of charged protons generated by a large magnetic unit called a *cyclotron*. The advantage of proton therapy is that it is capable of delivering its high-energy dose to a deep-seated tumor, with decreased doses of radiation to the tissues in front of the tumor while virtually no energy exits through the patient's healthy tissue behind the tumor (Halperin et al., 2013). Proton therapy permits treatment of deep tumors in close proximity to critical structures, such as the heart or major blood vessels.

Internal Radiation

Internal radiation includes localized implantation or systemic radionuclide administration. Brachytherapy delivers the dose of radiation to a localized area while systemic radiotherapy relies on strategies for getting the radionuclides closer to the tumor. The specific radioisotope used is selected on the basis of its half-life, which is the time it takes for half of its radioactivity to decay, and the depth of penetration of the radiation.

Brachytherapy

Brachytherapy is the placement of radioactive sources within or immediately next to the cancer site in order to provide a highly targeted, intense dose of radiation beyond a dose that is usually provided by EBRT. In addition, this form of radiation delivery helps to spare exposure to normal surrounding tissue. The radiation source can be implanted by means of needles or rods, seeds, beads, ribbons, or catheters placed into body cavities (vagina, abdomen, pleura), lumens within organs, or interstitial tissue compartments (breast, prostate). Multiple imaging techniques such as ultrasound, CT, or MRI are used to guide placement of radiation sources. Patients may have many fears or concerns about internal radiation, and the nurse explains the various approaches and safety precautions that will be used to protect the patient, family, and health care staff.

Brachytherapy may be delivered as a temporary or a permanent implant. Temporary applications are delivered as high-dose radiation (HDR) for short periods of time, while low-dose radiation (LDR) is delivered over a more extended period of time. The primary advantage of HDR brachytherapy is that treatment time is shorter, there is reduced exposure to personnel, and the procedure can be performed on an outpatient basis over several days. HDR brachytherapy can be used for intraluminal, surface, interstitial, and intra-cavitary lesions. Intraluminal HDR brachytherapy involves the insertion of catheters or hollow tubes into the lumens of organs so that the radioisotope can be delivered as close to the tumor bed as possible. Lesions in the bronchus, esophagus, rectum, or bile duct can be treated with this approach. Contact or surface application is used for treatment of tumors of the eye, such as retinoblastoma in children or ocular melanoma in adults.

Interstitial HDR implants, used in treating such malignancies as prostate, pancreatic, or breast cancer, may be temporary or permanent, depending on the site and radioisotope used. Based on the dose to be delivered (LDR or HDR), the implants may consist of seeds, needles, wires, strands, or small catheters positioned to provide a local radiation source. Prostate HDR therapy is one form of interstitial brachytherapy, in which radioactive strands or wires are placed, while the patient is under anesthesia, into hollow catheters that have been inserted in the perineum close to the prostate gland (Halperin et al., 2013).

Intracavitary radioisotopes are used to treat gynecologic cancers. In these malignancies, the radioisotopes are inserted into specially positioned applicators within the vagina. The applicator placement is verified by x-ray. Treatment can be achieved with either HDR or LDR brachytherapy sources, depending on the

extent of disease. LDR therapy requires hospitalization because the patient is treated over several days. HDR intraoperative radiotherapy (IORT) has been used as a treatment approach for advanced gynecologic cancer that has spread to the para-aortic area or pelvic wall (Lukens, Gamez, Hu, et al., 2014).

Systemic radiotherapy (radiopharmaceutical therapy) involves the intravenous (IV) administration of a therapeutic radioactive isotope targeted to a specific tumor. Radioactive iodine (I-131) is a widely used form of systemic brachytherapy that is the primary treatment for thyroid cancer (Beck, 2015). Radium-223 dichloride selectively targets prostate cancer bone metastases with high-energy, short-range alpha particles and is approved for the treatment of patients with symptomatic bone metastases and no known visceral metastatic disease (NCCN, 2015d). Radioisotopes are also used as a form of radioimmunotherapy for the treatment of refractory non-Hodgkin lymphoma. (See Chapter 28 for more information on lymphoma.)

Toxicity

Toxicities associated with radiation therapy are most often localized in the region being irradiated and may be increased if concomitant chemotherapy is given. Acute or early toxicities most often begin within 2 weeks of the initiation of treatment occur when normal cells within the treatment area are damaged and cellular death exceeds regeneration. Body tissues most affected are those that normally proliferate rapidly, such as the skin, the epithelial lining of the gastrointestinal tract, and the bone marrow.

Altered skin integrity is common and can include alopecia (hair loss) associated with whole brain radiation. Other skin reactions, referred to as radiation dermatitis, occur along a continuum ranging from erythema and dry desquamation (flaking of skin) to moist or wet desquamation (dermis exposed, skin oozing serous fluid) to, potentially, ulceration. Factors that contribute to the severity of radiation dermatitis include the dose and form of radiation, inclusion of skin folds in the irradiated area, increased age and the presence of medical comorbidities (Fogh & Yom, 2014). Symptoms of radiation dermatitis may necessitate treatment interruption, delays, or cessation of therapy. Re-epithelialization occurs after treatments have been completed. Hyperpigmentation, a less severe radiation-associated skin reaction, may develop about 2 to 4 weeks after the initiation of treatment.

Alterations in oral mucosa secondary to radiation therapy in the head and neck region include stomatitis (inflammation of the oral tissues), decreased salivation and xerostomia (dryness of the mouth), and change in or loss of taste. Depending on the targeted region, any portion of the gastrointestinal mucosa may be involved, causing mucositis (inflammation of the lining of the mouth, throat, and gastrointestinal tract). For example, patients receiving thoracic irradiation for lung cancer may experience acute esophageal irritation—associated chest pain and dysphagia. Anorexia, nausea, vomiting, and diarrhea may occur if the stomach or colon is in the radiation field. Symptoms subside and gastrointestinal re-epithelialization occurs after treatments have been completed. Bone marrow cells proliferate rapidly, and if sites containing bone marrow (e.g., the iliac crest or sternum) are included in the radiation field, anemia, leukopenia (decreased white blood cells [WBCs]), and thrombocytopenia (a decrease in platelets) may result. The patient is then at increased risk for infection and bleeding until blood cell counts return to normal. One medication, amifostine (Ethyol), is occasionally used in patients with head and neck cancers to reduce acute and chronic xerostomia while preserving antitumor efficacy of the necessary radiation doses (Citrin & Mitchell, 2014).

Systemic side effects are commonly experienced by patients receiving radiation therapy. These include fatigue, malaise, and anorexia that may be secondary to substances released when tumor cells are destroyed. Early effects tend to be temporary and most often subside within 6 months of the cessation of treatment.

Late effects (approximately 6 months to years after treatment) of radiation therapy may occur in body tissues that were in the field of radiation. These effects are chronic, usually a result of permanent damage to tissues, loss of elasticity, and changes secondary to a decreased vascular supply. Severe late effects include fibrosis, atrophy, ulceration, and necrosis and may affect the lungs, heart, central nervous system, and bladder. With advances in treatment planning and the accuracy of treatment delivery, the occurrence of late toxicities has diminished. However, late or chronic symptoms, such as dysphagia, incontinence, cognitive impairment, and sexual dysfunction, may persist for several years with implications for survivors' overall health and quality of life (Oeffinger, 2013).

Nursing Management

Nurses anticipate, prevent, and work collaboratively with other providers to manage symptoms associated with radiation therapy in order to promote healing, patient comfort, and quality of life. Symptoms that are not appropriately managed may lead to poor outcomes as a result of interruptions, decreased doses, or early cessation of treatment (Fogh & Yom, 2014). Ideally, nurses consider factors that may be predictive of radiation toxicities or radiosensitivity of tissues. In particular, diminished body mass index (BMI) and elevated radiation doses have been associated with greater toxicity and symptoms (O'Gorman, Sasiadek, Denieffe, et al., 2015). The area of the body being irradiated partially guides the focus of nursing assessments.

In patients receiving EBRT, the nurse assesses the patient's skin regularly throughout the course of treatment. In addition, nutritional status and general feelings of well-being are assessed throughout the course of treatment. Evidence-based protocols for nursing management of the toxicities associated with radiation therapy are used. If systemic symptoms, such as weakness and fatigue, occur, the nurse explains that these symptoms are a result of the treatment and do not represent deterioration or progression of the disease.

Protecting Caregivers

When the patient has a radioactive implant in place, the nurse and other health care providers need to protect themselves, as well as the patient, from the effects of radiation. Patients receiving internal radiation emit radiation while the implant is in place; therefore, contact with the health care team is guided by principles of time, distance, and shielding to minimize exposure of personnel to radiation. Specific instructions are provided by the radiation safety officer from the radiology department and specify the maximum time that can be spent safely in the patient's room, the shielding equipment to be used, and special precautions and actions to be taken if the implant is dislodged (Halperin et al., 2013). Safety precautions used in caring for a patient receiving brachytherapy include assigning the patient to a private room, posting appropriate notices about radiation safety precautions, having staff members wear dosimeter badges, making sure that pregnant staff members are not assigned to the patient's care, prohibiting visits by children or pregnant visitors, limiting visits from others to 30 minutes daily, and seeing that visitors maintain a 6-foot distance from the radiation source.

Patients with seed implants typically are able to return home; radiation exposure to others is minimal. Information about any precautions, if needed, is provided to the patient and family members to ensure safety. Depending on the dose and energy emitted by a systemic radionuclide, patients may or may not require special precautions or hospitalization (Halperin et al., 2013). The nurse should explain the rationale for these precautions to keep the patient from feeling unduly isolated.

Chemotherapy

Chemotherapy involves the use of antineoplastic drugs in an attempt to destroy cancer cells by interfering with cellular functions, including replication and DNA repair (Grossman & Porth, 2014). Chemotherapy is used primarily to treat systemic disease rather than localized lesions that are amenable to surgery or radiation. Chemotherapy may be combined with surgery, radiation therapy, or both to reduce tumor size preoperatively (neoadjuvant), to destroy any remaining tumor cells postoperatively (adjuvant), or to treat some forms of leukemia or lymphoma (primary). The goals of chemotherapy (cure, control, or palliation) must be realistic because they will determine the medications that are used and the aggressiveness of the treatment plan.

Cell Kill and the Cell Cycle

Each time a tumor is exposed to chemotherapy, a percentage of the tumor cells (20% to 99%, depending on dosage and agent) are destroyed. Repeated doses of chemotherapy are necessary over a prolonged period to achieve regression of the tumor. Eradication of 100% of the tumor is almost impossible; the goal of treatment is eradication of enough of the tumor so that the remaining malignant cells can be destroyed by the body's immune system (Grossman & Porth, 2014)

Actively proliferating cells within a tumor are the most sensitive to chemotherapy (the ratio of dividing cells to resting cells is referred to as the growth fraction). Non-dividing cells capable of future proliferation are the least sensitive to antineoplastic medications and consequently are potentially dangerous. However, the non-dividing cells must be destroyed to eradicate the disease. Repeated cycles of chemotherapy or sequencing of multiple chemotherapeutic agents is used to achieve more tumor cell destruction by destroying the non-dividing tumor cells as they begin active cell division.

Reproduction of both healthy and malignant cells follows the cell cycle pattern (see Fig. 58-4). The cell cycle time is the time required for one cell to divide and reproduce two identical daughter cells. The cell cycle of any cell has four distinct phases, each with a vital underlying function (Grossman & Porth, 2014):

- G_1 phase—RNA and protein synthesis occurs
- S phase—DNA synthesis occurs
- G_2 phase—premitotic phase; DNA synthesis is complete, mitotic spindle forms
- Mitosis—duplicated chromosomes separate and cell division occurs

Classification of Chemotherapeutic Agents

Chemotherapeutic agents may be classified by their mechanism of action in relation to the cell cycle. Agents that exert their maximal effect during specific phases of the cell cycle are termed *cell cycle–specific agents.* These agents destroy cells that are actively reproducing by means of the cell cycle; most affect cells in the S phase by interfering with DNA and RNA synthesis. Other agents, such as plant alkaloids, are specific to the M phase, where they halt mitotic spindle formation. Chemotherapeutic agents that act independently of the cell cycle phases are termed *cell cycle–nonspecific agents.* These agents usually have a prolonged effect on cells, leading to cellular damage or death. Many treatment plans combine cell cycle–specific and cell cycle–nonspecific agents to increase the number of vulnerable tumor cells killed during a treatment period (Neuss, Polovich, McNiff, et al., 2013).

Chemotherapeutic agents are also classified by chemical group, each with a different mechanism of action. These include the alkylating agents, nitrosoureas, antimetabolites, antitumor antibiotics, topoisomerase inhibitors, plant alkaloids (also referred to as mitotic inhibitors), hormonal agents, and miscellaneous agents. The classification, mechanism of action, cell cycle specificity, and common side effects of selected antineoplastic agents are listed in Table 58-8.

Chemotherapeutic agents from multiple categories may be used together to maximize cell destruction. Combination chemotherapy

TABLE 58-8 Select Antineoplastic Agents

Drug Class and Examples	Mechanism of Action	Cell Cycle Specificity	Common Side Effects
Alkylating Agents			
Busulfan (Busulfex, Myleran), carboplatin (Paraplatin), chlorambucil (Leukeran), cisplatin (Platinol-AQ), cyclophosphamide (Cytoxan), dacarbazine (DTIC-Dome), altretamine (Hexalen), ifosfamide (Ifex), melphalan (Alkeran), nitrogen mustard (Mustargen), oxaliplatin (Eloxatin), thiotepa (Thioplex)	Bond with DNA, RNA, and protein molecules leading to impaired DNA replication, RNA transcription, and cell functioning; all resulting in cell death	Cell cycle—nonspecific	Bone marrow suppression, nausea, vomiting, cystitis (cyclophosphamide, ifosfamide), stomatitis, alopecia, gonadal suppression, renal toxicity (cisplatin), and development of secondary malignancies
Nitrosoureas			
Carmustine (BCNU [BiCNU, Gliadel]), lomustine or CCNU (CeeNU), semustine (methyl-CCNU [MeCCNU]), streptozocin (Zanosar)	Similar to alkylating agents; cross the blood–brain barrier	Cell cycle—nonspecific	Delayed and cumulative myelosuppression, especially thrombocytopenia; nausea, vomiting, pulmonary, hepatic and renal damage

(Continued)

(Continued)

Topoisomerase I Inhibitors			
Irinotecan (Camptosar) Topotecan (Hycamtin) ***Topoisomerase II Inhibitors*** Etoposide (Etopophos, VePesid) Teniposide (Vumon, VM-26)	Induce breaks in the DNA strand by binding to enzyme topoisomerase, preventing cells from dividing	Cell cycle—specific (S phase)	Bone marrow suppression, diarrhea, nausea, vomiting, flulike symptoms (topotecan), rash (etoposide), hepatotoxicity (teniposide)
Antimetabolites			
5-Azacytidine (Vidaza), capecitabine (Xeloda), cytarabine (DepoCyt, Tarabine), edatrexate fludarabine (Fludara), 5-fluorouracil (5-FU), gemcitabine (Gemzar), hydroxyurea (Droxia, Hydrea), cladribine (Leustatin), 6-mercaptopurine (Purinethol), methotrexate (Trexall, Rheumatrex), pentostatin (Nipent), 6-thioguanine (Tabloid)	Interferes with the biosynthesis of metabolites or nucleic acids necessary for RNA and DNA synthesis; inhibits DNA replication and repair	Cell cycle—specific (S phase)	Nausea, vomiting, diarrhea, bone marrow suppression, stomatitis, renal toxicity (methotrexate), hepatotoxicity (6-thioguanine), hand-foot syndrome (capecitibine)
Antitumor Antibiotics			
Bleomycin (BLM, Blenoxane), dactinomycin (Cosmegen), daunorubicin (DaunoXome), doxorubicin (Adriamycin), epirubicin, idarubicin (Idamycin), mitomycin (Mutamycin), mitoxantrone (Novantrone), plicamycin (Mithracin)	Interfere with DNA synthesis by binding DNA; prevent RNA synthesis	Cell cycle—nonspecific	Bone marrow suppression, nausea, vomiting, alopecia, anorexia, cardiac toxicity (daunorubicin, doxorubicin), red urine (doxorubicin, idarubicin, epirubicin), pulmonary fibrosis (bleomycin)
Mitotic Spindle Inhibitors			
Plant alkaloids: Vinblastine (Velban), vincristine (VCR [Oncovin]), vinorelbine (Navelbine)	Arrest metaphase by inhibiting mitotic tubular formation (spindle); inhibit DNA and protein synthesis	Cell cycle—specific (M phase)	Bone marrow suppression (mild with VCR), peripheral neuropathies, nausea and vomiting
Taxanes: Paclitaxel (Taxol), docetaxel (Taxotere)	Arrest metaphase by inhibiting tubulin depolymerization	Cell cycle—specific (M phase)	Hypersensitivity reactions, bone marrow suppression, alopecia, peripheral neuropathies, **mucositis**
Epothilones: Ixabepilone (Ixempra)	Alters microtubules and inhibits mitosis	Cell cycle—specific (M phase)	Peripheral neuropathies, bone marrow suppression, hypersensitivity reactions, hepatic impairment
Hormonal Agents			
Androgens and antiandrogens, estrogens and antiestrogens, progestins and antiprogestins, aromatase inhibitors, luteinizing hormone-releasing hormone analogues, steroids	Bind to hormone receptor sites that alter cellular growth; block binding of estrogens to receptor sites (antiestrogens); inhibit RNA synthesis; suppress cytochrome P450 system	Cell cycle—nonspecific	Hypercalcemia, jaundice, increased appetite, masculinization, feminization, sodium and fluid retention, nausea, vomiting, hot flashes, vaginal estrogen dryness
Miscellaneous Agents			
Asparaginase (Elspar), procarbazine (Matulane)	Inhibits protein, DNA, and RNA synthesis	Varies	Anorexia, nausea, vomiting, bone marrow suppression, hepatotoxicity, hypersensitivity reaction, pancreatitis
Arsenic trioxide (Trisenox)	Causes fragmentation of DNA resulting in cell death; in acute promyelocytic leukemia, it corrects protein changes and changes malignant cells into normal white blood cells.		Nausea, vomiting, electrolyte imbalances, fever, headache, cough, dyspnea, electrocardiogram abnormalities

DNA, deoxyribonucleic acid; RNA, ribonucleic acid.

Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia: Wolters Kluwer; Neuss, M. N., Polovich, M., McNiff, K., et al. (2013). 2013 Updated American Society of Clinical Oncology/Oncology Nursing Society chemotherapy administration safety standards including standards for the safe administration and management of oral chemotherapy. Oncology Nursing Forum, 40(3), 225–233.

relies on agents with varying mechanisms, potential synergistic actions, and differing toxicities. The use of combination therapy also helps prevent the development of drug-resistant cells.

Adjunct Chemotherapeutic Agents

In certain regimens, additional medications are given with chemotherapy agents to enhance activity or protect normal cells from injury. For example, leucovorin (Wellcovorin) is often given with fluorouracil (5-FU) to treat colorectal cancer. Leucovorin, a compound similar to folic acid, helps fluorouracil bind with an enzyme inside of cancer cells and enhances the ability of fluorouracil to remain in the intracellular environment. Leucovorin also rescues normal cells from the toxic effects of high doses of methotrexate (Trexall). When given at certain doses for the treatment of some forms of leukemia or lymphoma, methotrexate causes a folic acid deficiency in cells, resulting in cell death. Significant toxicity, including severe bone marrow suppression, mucositis, diarrhea and liver, and lung and kidney damage, can occur. Leucovorin helps to prevent or lessen these toxicities.

Administration of Chemotherapeutic Agents

Chemotherapy may be given in the hospital, outpatient center, or home setting by multiple routes. The route of administration depends on the type of agent; the required dose; and the type, location, and extent of malignant disease being treated. Standards for the safe administration of chemotherapy have been developed by the Oncology Nursing Society (ONS) and the American Society of Clinical Oncology (ASCO) (Neuss et al., 2013). Patient education is essential to maximize safety when chemotherapy is given in the home.

Dosage

The dosage of chemotherapeutic agents is based primarily on the patient's total body surface area, weight, previous exposure and response to chemotherapy or radiation therapy, and function of major organ systems. Dosages are determined to maximize cell kill while minimizing impact on healthy tissues and subsequent toxicities. The therapeutic effect may be compromised if modified and inadequate dosing is required due to toxicities. Modification of dosage is often required if critical laboratory values or the patient's symptoms indicate unacceptable or dangerous toxicities. Chemotherapy treatment regimens include standard-dose therapy, dose-dense regimens (giving chemotherapy more frequently than standard treatment regimens), and myeloablative therapy for HSCT. For certain chemotherapeutic agents, there is a maximum lifetime dose limit that must be adhered to because of the danger of long-term irreversible organ complications (e.g., because of the risk of cardiomyopathy, doxorubicin [Adriamycin] has a cumulative lifetime dose limit of 550 mg/m^2).

Extravasation

Intravenously given chemotherapy agents are additionally classified by their potential to damage tissue if they inadvertently leak from a vein into surrounding tissue (extravasation). The consequences of extravasation range from mild discomfort to severe tissue destruction, depending on whether the agent is classified as a nonvesicant, irritant, or vesicant. The pH levels of irritant agents (<5 or >9) induce inflammatory reactions but usually cause no permanent tissue damage (Schulmeister, 2014).

Vesicants are those agents that, if deposited into the subcutaneous or surrounding tissues (extravasation), cause inflammation; tissue damage; and possibly necrosis of tendons, muscles, nerves, and blood vessels. Although the mechanism of vesicant actions varies with each drug, some agents bind to cell DNA and cause cell death that progresses to involve neighboring cells, whereas other agents are metabolized into cells and cause a localized, painful reaction that usually improves over time (Schulmeister, 2014). Sloughing and ulceration of the tissue may progress to tissue necrosis that is so severe that skin grafting becomes necessary. The full extent of tissue damage may take several weeks to become apparent. Examples of commonly used agents classified as vesicants include dactinomycin (Cosmegen), daunorubicin (DaunoXome), doxorubicin (Adriamycin), nitrogen mustard (Mustargen), mitomycin (Mutamycin), vinblastine (Velban), and vincristine (Oncovin). Chemotherapy administration safety standards require the availability of defined extravasation management procedures, including antidote order sets and accessibility of antidotes in all settings where vesicant chemotherapy is given (Neuss et al., 2013); (Schulmeister, 2014).

Chemotherapy is given only by those who have the knowledge and established competencies for vesicant and extravasation management (Schulmeister, 2014). Prevention and management of extravasation are essential. Vesicant chemotherapy should never be given in peripheral veins involving the hand or wrist. Peripheral administration is permitted for short-duration infusions only, and placement of the venipuncture site should be on the forearm area using a soft, plastic catheter. For any frequent or prolonged administration of antineoplastic vesicants, right atrial silastic catheters, implanted venous access devices, or peripherally inserted central catheters (PICCs) should be inserted to promote safety during medication administration and reduce problems with access to the circulatory system (Figs. 58-5 and 58-6).

Hypersensitivity Reactions

Although hypersensitivity reactions (HSRs) can occur with any medication, many chemotherapy agents pose a high risk and

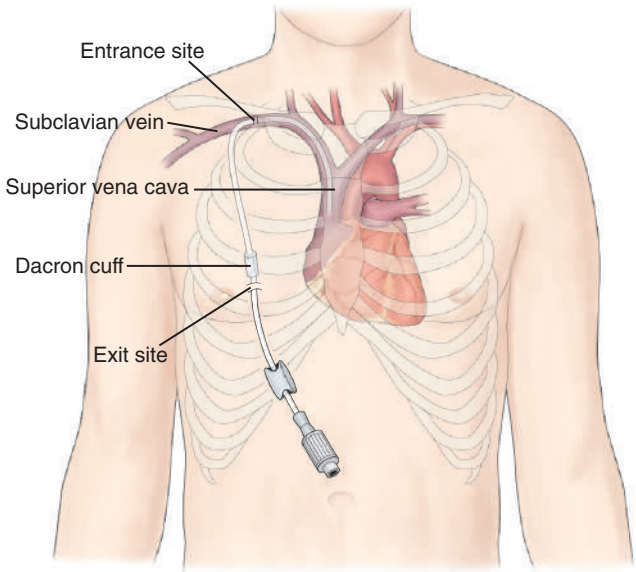


Figure 58-5 • Right atrial catheter. The right atrial catheter is inserted into the subclavian vein and advanced until its tip lies in the superior vena cava just above the right atrium. The proximal end is then tunneled from the entry site through the subcutaneous tissue of the chest wall and brought out through an exit site on the chest. The Dacron cuff anchors the catheter in place and serves as a barrier to infection.

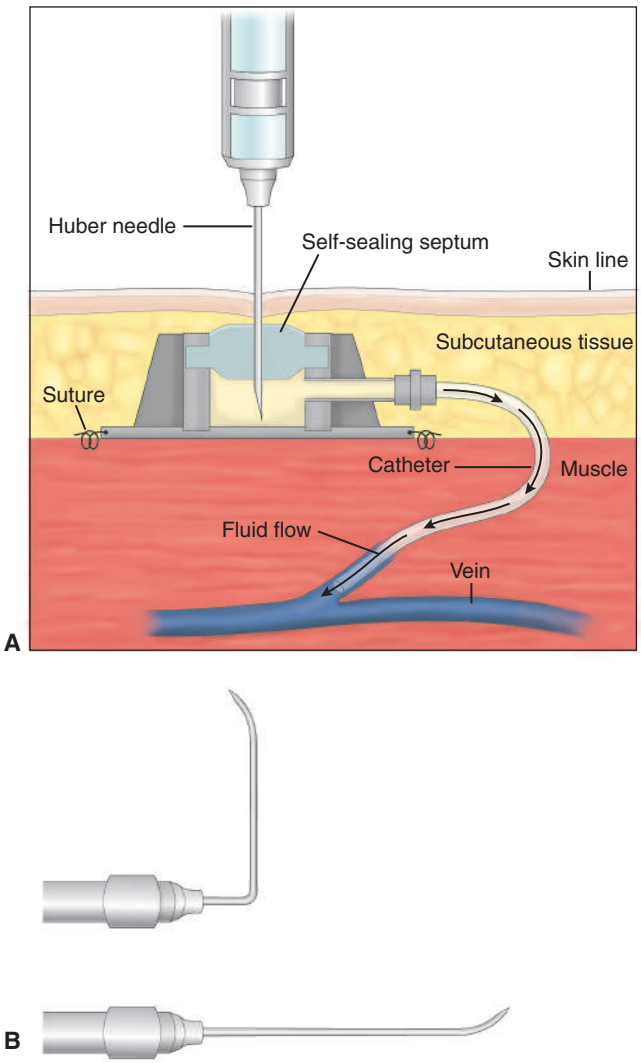


Figure 58-6 • Implanted vascular access device. **A.** A schematic diagram of an implanted vascular access device used for administration of medications, fluids, blood products, and nutrition. The self-sealing septum permits repeated puncture by Huber needles without damage or leakage. **B.** Two Huber needles used to enter the implanted vascular port. The 90-degree needle is used for top-entry ports for continuous infusions.

have been associated with life-threatening outcomes. HSRs are a subgroup of adverse drug reactions that are unexpected and associated with mild or progressively worsening signs and symptoms, such as rash, urticaria, fever, hypotension, cardiac instability, dyspnea, wheezing, throat tightness, and syncope (Braskett & Cohen, 2014). Immediate HSRs appear within 1 hour of an infusion, while delayed HSRs may occur hours afterward. Although patients may or may not react to the first infusion of a chemotherapy agent, repeated exposure increases the likelihood of a reaction.

Most immediate HSRs are immunoglobulin E (IgE)-mediated reaction—an allergic reaction. Examples of agents that may cause an allergic, IgE-mediated response include carboplatin, oxaliplatin (Eloxatin), and L-asparaginase. However, some HSRs, such as anaphylactoid reactions, are non–IgE-mediated (nonallergic) and a result of cytokine release syndrome (Braskett & Cohen, 2014); (Castells, 2015). Rituximab and cetuximab are examples of agents associated with non-IgE-mediated (nonallergic) HSRs. When signs and symptoms of HSR occur, the medication should be discontinued immediately and emergency procedures initiated. Many institutions have developed specific protocols for responding to HSRs, including standing orders for administration of emergency medications (Castells, 2015). (Chapter 56 presents further discussion of allergic reactions.)

For some chemotherapeutic agents, especially if they are essential in the treatment plan, desensitization procedures may be possible, and the patient is retreated with the agent at reduced dosages or slower infusion rates. Premedication regimens are used for certain chemotherapy agents to prevent or minimize reactions.

Toxicity

Toxicity associated with chemotherapy can be acute or chronic. Cells with rapid growth rates (e.g., epithelium, bone marrow, hair follicles, sperm) are very susceptible to damage, and the effects may manifest in virtually any body system.

Gastrointestinal System

The most common side effects of chemotherapy are nausea and vomiting, which may persist for 24 to 48 hours; delayed nausea and vomiting may occur up to 1 week after administration. The experience of chemotherapy-induced nausea and vomiting (CINV) may affect quality of life, psychological status, nutrition, fluid and electrolyte status, functional ability, compliance with treatment, and utilization of health care resources (Gonella & Di Giulio, 2015). Comorbidities, the underlying malignancy, other treatment approaches, and medications, as well as symptoms (i.e., pain), may contribute to CINV. Acute CINV is experienced in the first 24 hours after chemotherapy with a maximal intensity after 5–6 hours; delayed CINV occurs 24 hours posttreatment and may last as many as 7 days with a maximal intensity 48–72 hours after drug administration (Gonella & Di Giulio, 2015). Anticipatory nausea and vomiting, occurring prior to administration of chemotherapy, may be a conditioned response triggered by a stimulus such as the smell of the infusion setting, the sight of the nurse, or the outpatient center waiting room.

Several mechanisms are responsible for the occurrence of nausea and vomiting, including activation of multiple receptors found in the vomiting center of the medulla, the chemoreceptor trigger zone, the gastrointestinal tract, the pharynx, and the cerebral cortex. Activation of neurotransmitter receptors in these areas is thought to induce CINV. Stimulation may originate through peripheral, autonomic, vestibular, or cognitive pathways. The primary neuroreceptors known to be implicated in CINV are 5-hydroxytryptamine (5-HT or serotonin) and dopamine receptors (NCCN, 2015e).

The approach for managing CINV is based on the knowledge of the probability of emesis of the chemotherapy agents used. Algorithms are used to prevent and treat CINV based on national guidelines that consider this classification of chemotherapy agents (NCCN, 2015e).

Corticosteroids, phenothiazines, sedatives, and histamines are helpful, especially when used in combination with serotonin blockers to provide antiemetic protection (NCCN, 2015e). In order to manage delayed nausea and vomiting, antiemetic medications may be combined and are given for the first week at home after chemotherapy. Nonpharmacologic approaches such as relaxation techniques, imagery, acupressure, or acupuncture can help decrease stimuli contributing to symptoms and may be

most helpful for patients with anticipatory nausea and vomiting. Small, frequent meals, bland foods, and comfort foods may reduce the frequency or severity of symptoms.

Stomatitis is commonly associated with some chemotherapy agents because of the rapid turnover of epithelium that lines the oral cavity. The entire gastrointestinal tract is susceptible to mucositis (inflammation of the mouth, throat, and gastrointestinal tract) with diarrhea. Antimetabolites and antitumor antibiotics are the major culprits in mucositis and other gastrointestinal symptoms, which can be severe in some patients.

Hematopoietic System

Many chemotherapy agents cause some degree of myelosuppression (depression of bone marrow function), resulting in decreased WBCs (leukopenia), granulocytes (neutropenia), red blood cells (RBCs) (anemia), and platelets (thrombocytopenia) and increased risk of infection and bleeding. Depression of these cells is the usual reason for limiting the dose of the chemotherapy. Myelosuppression is predictable; for most agents, patients usually reach the point at which blood counts are lowest 7 to 14 days after chemotherapy has been given. During these 2 weeks, nurses anticipate associated toxicities, especially a fever associated with neutrophil count less than 1,500 cells/mm^3. Frequent monitoring of blood cell counts is essential, and patients are educated about strategies to protect against infection, injury, and blood loss, particularly while counts are low (Manea, 2014).

Other agents—colony-stimulating factors (granulocyte colony-stimulating factor [G-CSF] and granulocyte-macrophage colony-stimulating factor [GM-CSF])—can be given after chemotherapy to stimulate the bone marrow to produce WBCs, especially neutrophils, at an accelerated rate, thus decreasing the duration of neutropenia. G-CSF and GM-CSF decrease the episodes of infection and the need for antibiotics and allow for more timely treatment cycles of chemotherapy with less need to reduce the dosage. Erythropoietin (EPO) stimulates RBC production, thus decreasing the symptoms of treatment-induced chronic anemia and reducing the need for blood transfusions. Interleukin 11 (IL-11) (oprelvekin [Neumega]) stimulates the production of megakaryocytes (precursors to platelets) and can be used to prevent and treat severe thrombocytopenia but has had limited use because of toxicities, such as HSR; capillary leak syndrome; pulmonary edema; atrial dysrhythmias; and nausea, vomiting, and diarrhea (Kuter, 2015).

Renal System

Some chemotherapy agents damage the kidneys because they impair water secretion, leading to syndrome of inappropriate secretion of antidiuretic hormone (SIADH), decrease renal perfusion, precipitate end products after cell lysis, and cause interstitial nephritis (Comerford, 2015). Cisplatin (Platinol), methotrexate, and mitomycin (Mutamycin) are particularly toxic to the kidneys. Rapid tumor cell lysis after chemotherapy results in increased urinary excretion of uric acid, which can cause renal damage. In addition, intracellular contents are released into the circulation, resulting in hyperkalemia, hyperphosphatemia, and hypocalcemia and obstructive nephropathy. (See later discussion of tumor lysis syndrome.)

Monitoring laboratory values of blood urea nitrogen (BUN), serum creatinine, creatinine clearance, and serum electrolytes is essential (Comerford, 2015). Adequate hydration, diuresis, alkalinization of the urine to prevent formation of uric acid crystals, and administration of allopurinol (Zyloprim) may be used to prevent renal toxicity. Amifostine has demonstrated an ability to minimize renal toxicities associated with cisplatin, cyclophosphamide (Cytoxan), and ifosfamide (Ifex) therapy.

Hemorrhagic cystitis is a bladder toxicity that can result from cyclophosphamide and ifosfamide therapy. Hematuria can range from microscopic to frank bleeding with symptoms ranging from transient irritation during urination, dysuria, and suprapubic pain to life-threatening hemorrhage. Protection of the bladder focuses on aggressive IV hydration, frequent voiding, and diuresis. Mesna (Mesnex) is a cytoprotectant agent that binds with the toxic metabolites of cyclophosphamide or ifosfamide in the kidneys to prevent hemorrhagic cystitis.

Cardiopulmonary System

Several agents are associated with cardiac toxicity. Anthracyclines (e.g., daunorubicin, doxorubicin) are known to cause irreversible cumulative cardiac toxicities, especially when total dosage reaches 300 mg/m^2 and 550 mg/m^2, respectively (Comerford, 2015). If these agents are given in the presence of thoracic radiation therapy or other agents with cardiotoxicity potential, the cumulative dose limit is lower. Patients at increased risk for the development of cardiopulmonary toxicities include those older than 70 years, those with a history of preexisting cardiac disease, hypertension, tobacco use, renal or hepatic dysfunction, and longer survival time. Dexrazoxane (Zinecard) has been used on a limited basis as a cardioprotectant when doxorubicin is needed in individuals who have already received a cumulative dose limit and continuation of therapy is deemed beneficial. Patients with known cardiac disease (e.g., heart failure) are treated with lower doses or agents not known to be associated with cardiac toxicity. Cardiac ejection fraction (volume of blood ejected from the heart with each beat) and other signs of heart failure must be monitored closely.

Bleomycin (Blenoxane), carmustine (BCNU), busulfan (Busulfex, Myleran), mitomycin, and paclitaxel/docetaxel, among other agents, have toxic effects on lung function, such as alveolar damage, bronchospasm, pneumonitis, and pulmonary fibrosis. Therefore, patients are monitored closely for changes in pulmonary function, including pulmonary function test results. Patients with known lung disease are treated with alternative agents not known to cause pulmonary toxicity. When pulmonary toxicity occurs, the agent is stopped and patients are treated with steroids and other supportive therapies (Schulmeister, 2014).

Capillary leak syndrome with resultant pulmonary edema is an effect of cytarabine (DepoCyt, Tarabine, Ara-C), mitomycin C, cyclophosphamide, and carmustine. Subtle onset of dyspnea and cough may progress rapidly to acute respiratory distress and subsequent respiratory failure. Patients who are at significant risk for capillary leak syndrome are monitored closely.

Reproductive System

Testicular and ovarian function can be affected by chemotherapeutic agents, resulting in possible sterility. Women may develop problems with ovulation or early menopause, whereas men may develop temporary or permanent azoospermia (absence of spermatozoa). Because treatment may damage reproductive cells, banking of sperm is often recommended for men before treatment is initiated (Frankel Kelvin, 2015). Options available for women prior to initiation of chemotherapy include freezing (cryopreservation) of oocytes, embryos, or ovarian tissue (Frankel Kelvin, 2015). Patients and their partners are informed

about potential changes in reproductive function resulting from chemotherapy. In addition, many chemotherapy agents are known or thought to be teratogenic. Therefore, patients are advised to use reliable methods of birth control while receiving chemotherapy and not to assume that sterility has resulted.

Neurologic System

Chemotherapy-induced neurotoxicity, a potentially dose-limiting toxicity, can affect the central nervous system, peripheral nervous system, and/or the cranial nerves. Neurotoxicity characterized by metabolic encephalopathy can occur with ifosfamide, high-dose methotrexate, and cytarabine. With repeated doses, the taxanes and plant alkaloids, especially vincristine, can cause cumulative peripheral nervous system damage with sensory alterations in the feet and hands. These sensations can be described as tingling, pricking, or numbness of the extremities; burning or freezing pain; sharp, stabbing, or electric shock–like pain; and extreme sensitivity to touch. If unreported by patients or undetected, progressive motor axon damage can lead to loss of deep tendon reflexes, with muscle weakness, loss of balance and coordination, and paralytic ileus.

Severe peripheral neuropathies may lead to diminished quality of life and functional abilities and result in dose reductions, a change in chemotherapy regimen, or early cessation of treatment (Tofthagen, Visovsky, & Hopgood, 2013). Although often reversible, these side effects may take many months to resolve or persist indefinitely. Along with the usual paresthesias of the hands and feet, oxaliplatin has a unique and frightening neurotoxicity presentation that is often precipitated by exposure to cold and is characterized by pharyngolaryngeal dysesthesia consisting of lip paresthesia, discomfort or tightness in the back of the throat, inability to breathe, and jaw pain.

Nursing Alert: Patients receiving oxaliplatin must be instructed to avoid drinking cold fluids or going outside with hands and feet exposed to cold temperatures to avoid exacerbation of these symptoms. Cisplatin may cause peripheral neuropathies and hearing loss due to damage to the acoustic nerve.

Cognitive Impairment

Many patients with cancer experience difficulty with remembering dates, multitasking, managing numbers and finances, organization, face or object recognition, inability to follow directions, feeling easily distracted, and motor and behavioral changes. Although not completely understood, these are viewed as symptoms of cognitive impairment, defined as a decline in the information-handling processes of attention and concentration, executive function, information processing speed, language, visual-spatial skill, psychomotor ability, learning, and memory (Von Ah, 2015). Commonly referred to by patients as "chemo brain," cognitive impairment has been associated with both cancer and cancer treatments, including surgery, radiation, chemotherapy, and targeted agents (Bender & Thelen, 2013). The symptoms may be subtle or profound with potential negative effects on functional abilities, employment, independence, quality of life, and psychosocial status. Comorbidities, age, medications, pain, impaired nutrition, anemia, fatigue, fluid and electrolyte disturbances, organ dysfunction, infection, and hormonal imbalances are factors that may contribute to the experience of cognitive impairment and make it difficult to fully understand. Underlying mechanisms of cognitive impairment in patients with cancer being explored include neurotoxic effects, oxidative stress, hormonal changes, immune dysregulation, cytokine release, clotting, genetic predisposition, and accelerated aging processes (Merriman, Von Ah, Miaskowski, et al., 2013); (Von Ah, 2015).

Fatigue

Cancer-related fatigue has been defined as an unusual, persistent, and subjective sense of tiredness that is not proportional to recent activity and interferes with usual functioning (NCCN, 2015f). Fatigue is a distressing side effect for most patients that greatly affects quality of life, during treatment and for months after treatment. The health care team works together to identify effective pharmacologic and nonpharmacologic approaches for fatigue management.

Nursing Management

Nurses play an important role in assessing and managing many of the problems experienced by patients receiving chemotherapy. Chemotherapy agents affect both normal and malignant cells; therefore, their effects are often widespread, affecting many body systems.

Laboratory and physical assessments of metabolic indices and the dermatologic, hematologic, hepatic, renal, cardiovascular, neurologic, and pulmonary systems are critical in evaluating the body's response to chemotherapy. These assessments are performed prior to, during, and after a course of chemotherapy to determine optimal treatment options, evaluate the patient's response, and monitor toxicity. Patients are monitored for long-term effects of chemotherapy after active treatment has been completed during the period of survivorship (see Chart 58-4).

Chart 58-4

Potential Long-Term Complications of Cancer Chemotherapy

- Abnormalities in senses of taste, smell, and touch
- Abnormal balance, tremors, or weakness
- Avascular necrosis
- Cardiovascular toxicity (coronary artery disease, myocardial infarction, congestive heart failure, valvular heart disease, peripheral arterial disease)
- Decreased libido
- Dental caries
- Dry mouth
- Dysphagia
- Dyspnea on exertion
- Growth retardation in children
- Herpes infections (zoster and varicella)
- Hypothyroidism
- Immune dysfunction
- Infertility
- Osteoporosis
- Pericarditis (acute or chronic)
- Pneumococcal sepsis
- Pneumonitis (acute or chronic)
- Secondary cancers:
  - Acute myeloid leukemia
  - Myelodysplastic syndromes
  - Non-Hodgkin lymphoma
  - Solid tumors (especially bone and soft tissue, lung, breast)
  - Thyroid cancer
  - Thymic hyperplasia

Assessing Fluid and Electrolyte Status

Anorexia, nausea, vomiting, altered taste, mucositis, and diarrhea put patients at risk for nutritional and fluid and electrolyte disturbances. Therefore, it is important for the nurse to assess the patient's nutritional and fluid and electrolyte status on an ongoing basis and to identify creative ways to encourage an adequate fluid and dietary intake.

Assessing Cognitive Status

Nurses should assess patients routinely for indications of cognitive impairment. Prior to the initiation of treatment, patients and families should be informed about the possibility of cognitive impairment. Nursing assessment plays an important role in determining the need for referral for neurocognitive evaluation and intervention (Jansen, 2013).

Modifying Risks for Infection and Bleeding

Suppression of the bone marrow and immune system is expected and frequently serves as a guide in determining appropriate chemotherapy dosage but increases the risk of anemia, infection, and bleeding disorders. Nursing assessment and care address factors that would further increase the patient's risk. The nurse's role in decreasing the risk of infection and bleeding is discussed further in the Nursing Care of Patients with Cancer section (see Chart 58-7).

Administering Chemotherapy

Nurses must be aware of chemotherapy and other agents most associated with HSRs, strategies for prevention, signs and symptoms characteristic of HSRs, and the appropriate early and time-sensitive interventions for preventing progression to anaphylaxis. Nurses provide patient and family education that emphasizes two key points: the importance of adhering to prescribed self-administered premedication before presenting to the infusion center, and recognizing and reporting the signs and symptoms to the nurse once the infusion has started. Patients and families are also educated about signs and symptoms that may occur at home following discharge from the infusion area that may warrant medication administration or immediate transport to the emergency department for further assessment and treatment.

The local effects of the chemotherapeutic agent are also of concern. The patient is observed closely during administration of the agent because of the risk and consequences of extravasation. Prevention of extravasation is essential and relies on vigilant nursing care (Neuss et al., 2013). Selection of peripheral veins, skilled venipuncture, and careful administration of medications are essential. Peripheral administration is limited to short duration (less than 1 hour; IV push or bolus) infusions using only a soft, plastic catheter placed in the forearm area. Continuous infusion of vesicants that takes longer than 1 hour or are given frequently are given only via a central line, such as a right atrial silastic catheter, implanted venous access device, or PICC. These long-term venous access devices promote safety during medication administration and reduce problems with repeated access to the circulatory system (see Figs. 58-5 and 58-6). Indwelling or subcutaneous venous access devices require consistent nursing care. Complications include infection and thrombosis (Cotogni, Barbero, Garrino, et al., 2015).

Indications of extravasation during administration of vesicant agents include the following:

- Absence of blood return from the IV catheter
- Resistance to flow of IV fluid
- Burning or pain, swelling, or redness at the site

Nursing Alert: If extravasation is suspected, the medication administration is stopped immediately.

An extravasation kit should be readily available with emergency equipment and antidote medications, as well as a quick reference for how to properly manage an extravasation of the specific vesicant agent used (although evidence-based data regarding effective antidotes are limited) (Gonzalez, 2013). Nurses should refer to their organization's policy and procedures for reporting, managing, and documenting extravasation. Safety standards require the availability of defined extravasation management procedures, including antidote order sets and accessibility of antidotes in all settings where vesicant chemotherapy is given (Neuss et al., 2013). Recommendations and guidelines for managing vesicant extravasation, which vary with each agent, have been issued by individual medication manufacturers, pharmacies, and the ONS (Neuss et al., 2013); (Schulmeister, 2014).

Difficulties or problems with administration of chemotherapeutic agents are brought to the attention of the primary provider promptly so that corrective measures can be taken to minimize local tissue damage.

The nurse evaluates the patient receiving neurotoxic chemotherapy, communicates findings with the medical oncologist, provides education to patients and families, and makes appropriate referrals for complete neurologic evaluation and occupational or rehabilitative therapies (Coyle, Griffie, & Czaplewski, 2014).

Preventing Nausea and Vomiting

Nurses are integral to the prevention and management of CINV. They collaborate with other members of the oncology care team to identify factors contributing to the experience of CINV and select effective antiemetic regimens that maximize currently available therapies. Nurses provide education for patients and families regarding antiemetic regimens and care for delayed CINV that may continue at home after the chemotherapy infusion has completed (NCCN, 2015e).

Managing Cognitive Changes

Although several approaches have been explored, no evidence-based guidelines for the prevention, treatment, or management of cognitive impairment have been established. Examples of nonpharmacologic approaches that nurses recommend to patients include exercise, natural restorative environmental intervention (walking in nature or gardening), and cognitive training programs (Merriman, et al., 2013); (Von Ah, 2015). Nurses should assist patients to address factors, such as fluid and electrolyte imbalances, nutrition deficits, fatigue, pain, and infection to minimize their contribution to cognitive impairment.

Managing Fatigue

Fatigue is a common side effect of chemotherapy. Nurses assist patients to explore the role that the underlying disease processes, combined treatments, other symptoms, and psychosocial distress play in the patient's experience of fatigue. In addition, nurses work with the patient and other team members to identify effective approaches for fatigue management (NCCN, 2015f).

Protecting Caregivers

Nurses involved in handling chemotherapeutic agents may be exposed to low doses of the agents by direct contact, inhalation, or ingestion. Studies suggest that nurses and others preparing chemotherapy agents or handling linens and other materials

that are contaminated with body fluids of patients receiving chemotherapy have been unknowingly exposed (Leduc-Souville, Bertrand, & Schlatter, 2013). Skin and eye irritation, nausea, vomiting, nasal mucosal ulcerations, infertility, low-birth-weight babies, congenital anomalies, spontaneous abortions, and mutagenic substances in urine have been reported in nurses preparing and handling chemotherapy agents (Leduc-Souville et al., 2013). The Occupational and Safety Health Administration (OSHA), the ONS, hospitals, and other health care agencies have developed specific precautions for health care providers involved in the preparation and administration of chemotherapy and for handling materials exposed to body fluids of those who have received these hazardous agents (see Chart 58-5) (Neuss et al., 2013); (Schulmeister, 2014). Nurses must be familiar with their institutional policies and procedures regarding personal protective equipment, handling and disposal of chemotherapy agents and supplies, and management of accidental spills or exposures. Emergency spill kits should be readily available in any treatment area where chemotherapy is prepared or given. Precautions must also be taken when handling any bodily fluids or excreta from the patient, as many agents are excreted unaltered in urine and feces. Nurses in all treatment settings have a responsibility to educate patients, families, caregivers, assistive personnel, and housekeepers concerning precautions.

Hematopoietic Stem Cell Transplantation

HSCT has been used to treat several malignant and nonmalignant diseases for many years. The use of HSCT for solid tumors is limited to clinical trials (Maziarz & Schubach-Slater, 2015). However, the use of HSCT in the treatment of certain adult hematologic malignancies (i.e., malignant myeloma, acute leukemia, and non-Hodgkin lymphoma) is considered standard of care.

The process of obtaining hematopoietic stem cells (HSCs) has evolved over the years. Historically, HSCs were obtained in the operating room by harvesting large amounts of bone marrow tissue from a donor under general anesthesia. However, peripheral blood stem cell collection using the process of apheresis has gained widespread use. The cells collected are specially processed and ultimately reinfused into the patient. This method of collecting HSCs is a safe and a more cost-effective means of collection than the process of harvesting of marrow (Maziarz & Schubach-Slater, 2015). Stem cells can also be collected from umbilical cord blood harvested from the placenta of newborns at birth.

Types

Types of HSCT are based on the source of donor cells and the treatment (conditioning) regimen used to prepare the patient for stem cell infusion and eradicate malignant cells. These include:

- *Allogeneic HSCT* (AlloHSCT): From a donor other than the patient (may be a related donor such as a family member or a matched unrelated donor from the National Bone Marrow Registry or Cord Blood Registry)
- *Autologous:* From the patient
- *Syngeneic:* From an identical twin
- *Myeloablative:* Consists of giving patients high-dose chemotherapy and, occasionally, total-body irradiation

Chart 58-5

Safety in Handling Chemotherapy for Health Care Providers

- When preparing (compounding, reconstituting) chemotherapy for administration, use the following safety equipment to prevent exposure through inhalation, direct contact, and ingestion:
  - Class II or III biological safety cabinet (BSC)
  - Closed system transfer devices
  - Puncture and leak-proof containers, IV bags
  - Needleless systems (i.e., IV tubing and syringes)
- If BSC is not available when preparing chemotherapy for administration, use the following safety equipment to minimize exposure:
  - Surgical N-95 respirator to provide respiratory and splash protection
  - Eye and face protection (both face shield and goggles) working at or above eye level or cleaning a spill
- When preparing or administering chemotherapy or handling linens and other materials contaminated with chemotherapy or blood and body fluids of patients receiving chemotherapy, wear the following for personal protection:
  - Double layer of powder-free gloves specifically designated for chemotherapy handling (the inner glove is worn under the gown cuff and the outer glove is worn over the cuff)
  - Long sleeve, disposable gowns (without seams or closures that can allow drugs to pass through) made of polyethylene-coated polypropylene or other laminate materials
- Linens contaminated with chemotherapy or blood and body fluids of patients receiving chemotherapy should be placed in the following:
  - Closed-system, puncture- and leak-proof containers labeled "hazardous: chemotherapy contaminated linens"
  - Above referenced container maintained in the infusion center soiled utility room for outpatient settings
  - Above referenced container maintained in the patient room and/or soiled utility room for inpatient settings
- Chemotherapy preparation equipment (i.e., syringes, tubing, empty vials, etc.), gowns, and gloves should be disposed of in:
  - Closed-system, puncture- and leak-proof containers labeled "hazardous: chemotherapy contaminated waste"
- Wash hands with soap and water after removing gloves used to prepare or administer chemotherapy or clean contaminated linens and other materials.
- "Spill kits" with the appropriate gowns, gloves, disposable absorbent materials for cleansing large areas, and hazard sign should be kept in all areas where chemotherapy is prepared and given.
- Implement a quality improvement program addressing safe chemotherapy handling that includes the following:
  - Standard operating policies and procedures for:
    - Chemotherapy handling, preparation, and disposal
    - Handling and disposal of chemotherapy spills
    - Handling and disposal of blood and body fluids and contaminated materials of patients receiving chemotherapy
  - Conduct competency-based education, training, and performance evaluations regarding chemotherapy safety procedures at orientation and at subsequent regular intervals.
  - Medical monitoring program to identify indicators of exposure
  - Root cause analysis for all chemotherapy spills and exposure incidents

Adapted from National Institute for Occupational Safety and Health. (2010). Personal protective equipment for health care workers who work with hazardous drugs. Available at: www.cdc.gov/niosh/docs/wp-solutions/2009–106/pdfs/2009–106.pdf

- *Nonmyeloablative:* Also called *mini-transplants;* does not completely destroy bone marrow cells

AlloHSCTs are used primarily for diseases of the bone marrow and are dependent on the availability of a human leukocyte antigen–matched donor, which greatly limits the number of possible transplants. An advantage of AlloHSCT is that the transplanted cells should not be immunologically tolerant of a patient's malignancy and should cause a lethal graft-versus-tumor effect in which the donor cells recognize the malignant cells and act to eliminate them.

AlloHSCT may involve either myeloablative (high-dose) or nonmyeloablative (mini-transplant) chemotherapy. In ablative AlloHSCT, the recipient receives high doses of chemotherapy and possibly total-body irradiation to completely eradicate (ablate) the bone marrow and any malignant cells and help prevent rejection of the donor stem cells. The collected HSCs that are infused IV into the recipients travel to sites in the body where they produce bone marrow and establish themselves through the process of engraftment. Once engraftment is complete (2 to 4 weeks, sometimes longer), the new bone marrow becomes functional and begins producing RBCs, WBCs, and platelets. In nonablative AlloHSCT, the chemotherapy doses are lower and are aimed at destroying malignant cells (without completely eradicating the bone marrow), thus suppressing the recipient's immune system to allow engraftment of donor stem cells. The lower doses of chemotherapy, associated with less organ toxicity and infection, can be used for older patients or those with underlying organ dysfunction for whom high-dose chemotherapy would be prohibitive. After engraftment, it is hoped that the donor cells will create a graft-versus-tumor effect. Before engraftment, patients are at high risk for infection, sepsis, and bleeding. Side effects of the high-dose chemotherapy and total-body irradiation can be acute and chronic. Acute side effects include alopecia, hemorrhagic cystitis, nausea, vomiting, diarrhea, encephalopathy, pulmonary edema, acute kidney injury, fluid and electrolyte imbalances, and severe mucositis (Maziarz & Schubach-Slater, 2015). Chronic side effects include sterility; pulmonary, cardiac, renal, neurologic, and hepatic dysfunction; osteoporosis; avascular bone necrosis; diabetes; and secondary malignancy (Maziarz & Schubach-Slater, 2015).

During the first 30 days after the conditioning regimen, AlloHSCT patients are at risk for developing hepatic sinusoidal obstructive syndrome (HSOS) (previously referred to as veno-occlusive disease) related to chemotherapy-induced inflammation of the sinusoidal epithelium. Inflammation causes embolization of RBCs, resulting in destruction, fibrosis, and occlusion of the sinusoids (Maziarz & Schubach-Slater, 2015). Signs and symptoms of HSOS may include weight gain, hepatomegaly, increased bilirubin, and ascites. Although various approaches have been used to treat HSOS, evidence-based strategies have not emerged. The use of peripheral stem cells, specific chemotherapy dosing, and nonmyeloablative regimens have been associated with a decreased incidence (Maziarz & Schubach-Slater, 2015).

Graft-versus-host disease (GVHD), a major cause of morbidity and mortality in 30% to 50% of the allogeneic transplant population, occurs when the donor lymphocytes initiate an immune response against the recipient's tissues (skin, gastrointestinal tract, liver) during the beginning of engraftment (Maziarz & Schubach-Slater, 2015). The donor cells view the recipient's tissues as foreign or immunologically different from what they recognize as "self" in the donor. To prevent GVHD, patients receive immunosuppressant drugs, such as cyclosporine (Sandimmune), methotrexate, tacrolimus (Prograf), or mycophenolate mofetil (MMF).

GVHD may be acute, occurring within the first 100 days, or chronic, occurring after 100 days (Barbarotta, 2015). Clinical manifestations of acute GVHD include diffuse rash progressing to blistering and desquamation similar to second-degree burns; mucosal inflammation of the eyes and the entire gastrointestinal tract with subsequent diarrhea that may exceed 2 L per day; and biliary stasis with abdominal pain, hepatomegaly, and elevated liver enzymes progressing to obstructive jaundice. The first 100 days or so after AlloHSCT is crucial for patients; the immune system and blood-making capacity (hematopoiesis) must recover sufficiently to prevent infection and hemorrhage. Most acute side effects, such as nausea, vomiting, and mucositis, resolve during this period of time. However, there are some complications that may occur, such as encephalopathy, hemolytic uremia syndrome, hemolytic anemia, and thrombotic thrombocytopenia purpura (Maziarz & Schubach-Slater, 2015).

Autologous HSCT (AuHSCT) is considered for patients with disease of the bone marrow who do not have a suitable donor for AlloHSCT or for patients who have healthy bone marrow but require bone marrow–ablative doses of chemotherapy to cure an aggressive malignancy. The most common malignancies treated with AuHSCT include lymphoma and multiple myeloma. However, the use of AuHSCT has gained increasing acceptance in treating neuroblastoma, Ewing sarcoma, and germ cell tumors (Maziarz & Schubach-Slater, 2015). Stem cells are collected from the patient and preserved for reinfusion; if necessary, they are treated to kill any malignant cells within the marrow, called *purging.* The patient is then treated with ablative chemotherapy and, possibly, total-body irradiation to eradicate any remaining tumor. Stem cells are then reinfused. Until engraftment occurs in the bone marrow sites of the body, there is a high risk of infection, sepsis, and bleeding. Acute and chronic toxicities from chemotherapy and radiation therapy may be severe. The risk of HSOS is also present after autologous transplantation. No immunosuppressant medications are necessary after AuHSCT, because the patient does not receive foreign tissue. A disadvantage of AuHSCT is the risk that tumor cells may remain in the bone marrow despite high-dose chemotherapy (conditioning regimens).

Syngeneic transplants result in less incidence of GVHD and graft rejection; however, there is also less graft-versus-tumor effect to fight the malignancy. Syngeneic transplant is associated with transmission of genetic defects (Maziarz & Schubach-Slater, 2015). For this reason, even when an identical twin is available for marrow donation, another matched sibling or even an unrelated donor may be the most suitable donor to combat an aggressive malignancy.

Nursing Management

Nursing care of patients undergoing HSCT is complex and demands a high level of skill. The success of HSCT is greatly influenced by nursing care throughout the transplantation process.

Implementing Care Before Treatment

All patients must undergo extensive evaluations before the transplant to assess the current clinical status of the disease. Nutritional assessments, extensive physical examinations, organ function tests, and psychological evaluations are conducted. Blood work includes assessing past infectious antigen exposure (e.g., hepatitis virus, cytomegalovirus, herpes simplex virus, human immunodeficiency virus, and syphilis). The patient's

social support systems and financial and insurance resources are also evaluated. Informed consent and patient education about the procedure and care before and after HSCT are vital.

Providing Care During Treatment

Skilled nursing care is required during the treatment phase of HSCT when high-dose chemotherapy (conditioning regimen) and total-body irradiation are given. The acute toxicities of nausea, diarrhea, mucositis, and hemorrhagic cystitis require close monitoring and symptom management by the nurse.

Nursing management during stem cell infusion consists of monitoring the patient's vital signs and blood oxygen saturation; assessing for adverse effects, such as fever, chills, shortness of breath, chest pain, cutaneous reactions, nausea, vomiting, hypotension or hypertension, tachycardia, anxiety, and taste changes; and providing strategies for symptom control, ongoing support, and patient education. During stem cell infusion, patients may experience adverse reactions to the cryoprotectant dimethyl sulfoxide (DMSO) used to preserve the harvested stem cells. These reactions may include nausea, vomiting, chills, dyspnea, cardiac dysrhythmias, and hypotension progressing to cardiac or respiratory arrest. Less common toxicities include neurologic and renal impairment (Maziarz & Schubach-Slater, 2015).

Nursing Alert: Until engraftment of the new marrow occurs, the patient is at high risk for death from sepsis and bleeding.

A cluster of symptoms referred to as engraftment syndrome may occur during the neutrophil recovery phase in both allogeneic and autologous transplants. Clinical features of this syndrome vary widely but may include noninfectious fever associated with skin rash, weight gain, diarrhea, and pulmonary infiltrates, with improvement noted after the initiation of corticosteroid therapy rather than antibiotic therapy (Maziarz & Schubach-Slater, 2015). Until engraftment is well established, the patient requires support with blood products and hematopoietic growth factors.

Potential infections may be bacterial, viral, fungal, or protozoan in origin. During the first 30 days following transplant, the patient is most at risk for developing reactivations of viral infections, including herpes simplex, EBV, cytomegalovirus, and varicella zoster. Mucosal denudement poses a risk for *Candida* (yeast) infection locally and systemically. Pulmonary toxicities offer the opportunity for fungal infections such as *Aspergillus.* Renal complications arise from the nephrotoxic chemotherapy agents used in the conditioning regimen or those used to treat infection (amphotericin B, aminoglycosides). A neutropenic diet is usually prescribed for patients to decrease the risk of exposure to foodborne infections from bacteria, yeast, molds, viruses, and parasites (Lassiter & Schneider, 2015). Whether a neutropenic diet decreases rates of infection is currently in question; see the nursing research profile in Chart 58-6.

Tumor lysis syndrome and acute tubular necrosis are also risks after HSCT. Nursing assessment for signs of these complications is essential for early identification and treatment. GVHD requires skillful nursing assessment to detect early effects on the skin, liver, and gastrointestinal tract. HSOS resulting from the conditioning regimens used can result in fluid retention, jaundice, abdominal pain, ascites, tender and enlarged liver, and encephalopathy. Pulmonary complications, such as pulmonary edema, interstitial pneumonia, and other pneumonias, often complicate recovery.

Providing Care After Treatment

Caring for Recipients

Ongoing nursing assessment during follow-up visits is essential to detect late effects of therapy after HSCT, which may occur 100 days or more after the procedure. Late effects include infections (e.g., varicella-zoster infection), restrictive pulmonary abnormalities, and recurrent pneumonias. Sterility often results due to total-body irradiation, chemotherapy, or both as components of the ablative regimen. Chronic GVHD can involve the skin, liver, intestine, esophagus, eyes, lungs, joints, and vaginal mucosa. Cataracts may also develop after total-body irradiation.

Chart 58-6 NURSING RESEARCH PROFILE

Do Neutropenic Diets Prevent Infection?

Lassiter, M., & Schneider, S. M. (2015). A pilot study comparing the neutropenic diet to a non-neutropenic diet in the allogeneic hematopoietic stem cell transplantation population. Oncology Nursing Forum, 19(3), 273–278.

Purpose

Despite years of implementation on oncology units, there is little evidence to support the use of a neutropenic diet. The purpose of this pilot study was to determine whether a neutropenic diet compared to a diet without restrictions made a difference in the incidence of infections and nutritional status of patients receiving myeloablative allogeneic hematopoietic stem cell transplantation (HSCT).

Design

This was a prospective randomized pilot study. A variety of laboratory measurements were collected for indications of infection (blood cultures) and to assess nutritional status. Laboratory measurements were compared between the control (neutropenic diet) and experimental (regular diet) arms using the two-sided Wilcoxon rank-sum test. Chi square was used to compare the percentage of patients with positive blood cultures in the two groups.

Findings

No significant differences between the control group (n = 21) and experimental group (n = 25) were found for demographic variables or patients who required total parenteral nutrition. Across all time points, no significant differences were found in any of the laboratory values with the exception of the total protein level. The median in the total protein level across all time points was 20% in the control arm and 16% in the experimental group, a significant difference (p = 0.023). Analysis of positive blood cultures failed to demonstrate any significant difference between the experimental and control groups.

Nursing Implications

Nurses should know that this pilot study provides beginning evidence that the neutropenic diet does not contribute to differences in infection rates or nutrition when compared to unrestricted diets in patients undergoing HSCT. Nurses need to conduct additional research with larger samples and multi-institutional involvement before the safety of changing this long-standing practice can be established.

The potential psychological impact of HSCT has been described as unique and unlike other experiences (Miceli, Lilleby, Noonan, et al., 2013). Psychosocial assessments by nursing staff must be ongoing and a priority. In addition to the multiple physical and psychological stressors affecting patients at each phase of the transplantation experience, the nature of the treatment and patient experience can place extreme emotional, social, financial, and physical demands on family, friends, and donors. Nurses assess the family and other caregivers' needs and provide education, support, and information about resources.

Caring for Donors

Like HSCT recipients, donors also require nursing care. They may experience mood alterations, decreased self-esteem, and guilt from feelings of failure if the transplantation fails. Family members must be educated and supported to reduce anxiety and promote coping during this difficult time. In addition, they must also be assisted to maintain realistic expectations of themselves as well as of the patient.

Hyperthermia

The use of hyperthermia (thermal therapy), which is the generation of temperatures greater than physiologic fever range (greater than 41.5°C [106.7°F]), has been used for many years to destroy cancerous tumors. Hyperthermia is most effective when combined with radiation therapy, chemotherapy, or biologic therapy. Hyperthermia and radiation therapy are thought to work well together because hypoxic tumor cells and cells in the S phase of the cell cycle are more sensitive to heat than radiation, and the addition of heat damages tumor cells so that they cannot repair themselves after radiation therapy. Hyperthermia preferentially damages tumor blood vessels, partly because these vessels are of inadequate size to dissipate the heat generated by hyperthermia.

Hyperthermia is thought to alter cellular membrane permeability when used with chemotherapy, allowing for an increased uptake of the chemotherapeutic agent. Hyperthermia may enhance the function of immune system cells, such as macrophages and T cells, to assist in combating malignant cells. Resistance to hyperthermia may develop during the treatment because cells adapt to repeated thermal insult.

Heat can be produced by using radio waves, ultrasound, microwaves, magnetic waves, hot-water baths, or even hot-wax immersions. Hyperthermia may be local or regional, or it may include the whole body. Local or regional hyperthermia may be delivered into a tumor, on the skin, into a body orifice, or by regional perfusion (i.e., an extremity affected by melanoma). Heated intraperitoneal chemotherapy has been used (in combination with surgery) to treat abdominal malignancies (Damsky-Dell, Held-Warmkessel, Jakubek, et al., 2014). Side effects of hyperthermia treatments include burns, fatigue, hypotension, peripheral neuropathies, thrombophlebitis, nausea, vomiting, diarrhea, and electrolyte imbalances. Cardiovascular stress may develop in patients receiving hyperthermia to a large area or whole body due to changes in pulse and blood pressure.

Nursing Management

Although hyperthermia has been used for years, patients and their families may be unfamiliar with this cancer treatment. Consequently, they need explanations about the procedure, its goals, and its effects. The nurse assesses the patient for adverse effects. Local skin care at the site of the implanted probes is necessary.

Targeted Therapies

Normal cell growth is regulated by well-defined communication pathways between the environment surrounding the cell and the internal cell environment, the nucleus, and the intracellular cytoplasm. The cell membrane contains important protein receptors that respond to signals transmitted from the external cell environment and transmit that signal to the internal cell environment using enzymatic pathways called *signal transduction pathways*. Although normal cells have transduction pathways, scientific advances have led to the recognition that cancer, at the cellular level, is characterized by deregulated cell signaling transduction pathways (both intra- and extracellular pathways), and receptors and proteins as well as altered cell membrane receptors and proteins play an important role in tumor initiation, growth, and spread (Caruana, Diaconu, & Dottia, 2014). This improved understanding of cancer cell behavior has allowed scientists to develop molecular-based therapies, called targeted therapies. These specifically target (like a lock and key mechanism) receptors, proteins, signal transduction pathways, and other processes to prevent the continued growth of cancer cells. Targeted therapies seek to work against cancer cell capabilities, such as malignant transformation, uncontrolled reproduction, growth and metastasis, blocking apoptosis, and altered genetic coding. Examples of targeted therapies include biologic response modifiers (BRMs) (such as monoclonal antibodies [MoAbs], growth factors and cytokines) and some types of gene therapy (Caruana et al., 2014).

Biologic Response Modifiers

BRM therapy involves the use of naturally occurring or recombinant (reproduced through genetic engineering) agents or treatment methods that can alter the immunologic relationship between the tumor and the patient with cancer (host) to provide a therapeutic benefit. Although the mechanisms of action vary with each type of BRM, the goal is to destroy or stop the malignant growth. The basis of BRM treatment lies in the restoration, modification, stimulation, or augmentation of the body's natural immune defenses against cancer (Blix, 2014).

Nonspecific Biologic Response Modifiers

Early investigations of the stimulation of the immune system involved nonspecific agents, such as bacille Calmette–Guérin (BCG) and *Corynebacterium parvum*. When injected into the patient, these agents serve as antigens that stimulate an immune response. The hope is that the stimulated immune system will then eradicate malignant cells. Extensive animal and human investigations with BCG have shown promising results, especially in treating localized malignant melanoma. In addition, BCG bladder instillation is a standard form of treatment for localized bladder cancer (Blix, 2014). However, the use of nonspecific agents in advanced cancer remains limited, and research is ongoing to identify other uses and agents.

Monoclonal Antibodies (MoAbs)

MoAbs, another type of BRM, have become available through technologic advances, enabling investigators to grow and produce targeted antibodies for specific malignant cells. Theoretically, this type of specificity allows MoAbs to destroy the cancer cells and spare normal cells. The specificity of MoAbs is dependent on identifying key antigen proteins on the surface of tumors that are not present on normal tissues. When the MoAb attaches to the cell surface antigen, an important

signal transduction pathway for communication between the malignant cells and the extracellular environment is blocked. The results may include an inability to initiate apoptosis, reproduce, or invade surrounding tissues.

The production of MoAbs involves injecting tumor cells that act as antigens into mice. B-cell lymphocytes in the spleen of the mouse produce immunoglobulin (antibodies) made in response to the injected antigens. Antibody-producing B cells are combined with a cancer cell that has the ability to grow indefinitely in culture medium and continue producing more antibodies.

The combination of spleen cells and the cancer cells is referred to as a hybridoma. From hybridomas that continue to grow in the culture medium, the desired antibodies are harvested, purified, and prepared for diagnostic or therapeutic use (see Fig. 58-7). Advances in genetic engineering have led to the production of MoAbs with combinations of mouse and human components (*chimeric MoAbs*) or all-human components (*human MoAbs*). MoAbs made with human genes have greater immunologic properties and are less likely to cause allergic reactions (Grossman & Porth, 2014).

Several MoAbs are used for treatment in cancer using various extracellular (on the cell membrane) and intracellular targets. Trastuzumab (Herceptin) has the ability to target the HER2 protein, an error of gene overexpression found in breast and other cancers (Comerford, 2015). Rituximab (Rituxan) is a MoAb that binds specifically with the CD20 antigen expressed by non-Hodgkin lymphoma and B-cell chronic lymphocytic leukemia (Comerford, 2015).

Some MoAbs are used alone, whereas others are used in combination with agents that facilitate their antitumor actions. Ibritumomab tiuxetan (Zevalin), a MoAb conjugated with a radioactive isotope, is used in the treatment of certain types of lymphoma (Mack, Ritchie, & Sapra, 2014). MoAbs are also used as aids in diagnostic evaluation of both primary and metastatic tumors through radiologic imaging and laboratory techniques. For example, the process of immunohistochemistry uses a MoAb tagged with a stain that binds with the protein of interest, providing a visual stain for the presence or absence of the protein (Mack et al., 2014). This type of test is used to identify the presence of estrogen and progesterone receptors on breast cancer cells to see if the cells will be responsive to hormonal agents. Immunohistochemistry testing is also used to detect several proteins associated with hereditary nonpolyposis colon cancer (Mack et al., 2014). MoAbs are used to assist in the diagnosis of ovarian, colorectal, breast, and prostate cancers and some types of leukemia and lymphoma. MoAbs are also used in purging residual tumor cells from peripheral stem cell collections for patients who are undergoing HSCT after high-dose cytotoxic therapy. Researchers continue to explore the development and use of MoAbs, either alone or in combination with other substances such as radioactive materials, chemotherapy agents, toxins, hormones, or other BRMs.

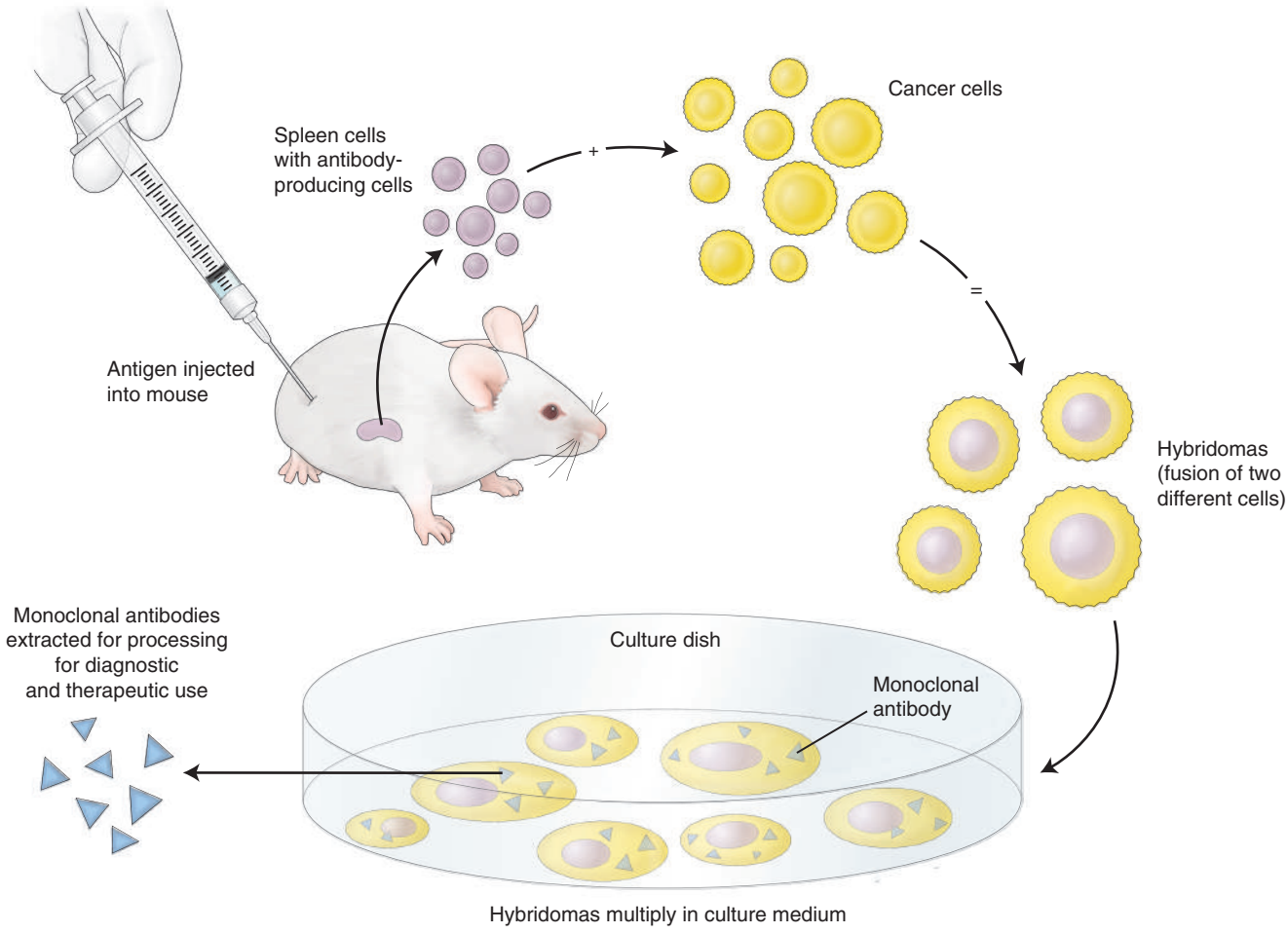


Figure 58-7 • Antibody-producing spleen cells are fused with cancer cells. This process produces cells called *hybridomas*. These cells, which can grow indefinitely in a culture medium, produce antibodies that are harvested, purified, and prepared for diagnostic or treatment purposes.

Cytokines

Cytokines, substances produced primarily by cells of the immune system to enhance or suppress the production and functioning of components of the immune system, are used to treat cancer or the adverse effects of some cancer treatments. Cytokines are grouped into families, such as interferons (IFNs), interleukins (ILs), and colony-stimulating factors. Colony-stimulating factors were described earlier in this chapter for their supportive role in myelosuppressive treatment modalities. (Refer to Chapter 54 for more detailed discussion of the immune system.)

Interferons (IFNs)

IFNs are cytokines with antiviral, antitumor, and immunomodulatory (inhibition or stimulation of the immune system) properties. Multiple antitumor effects of IFNs include antiangiogenesis, direct destruction of tumor cells, inhibition of growth factors, and disruption of the cell cycle (Weber, 2014). IFNs are used on a limited basis for the treatment of some solid and hematologic cancers. IFNs have been associated with significant toxicities, which have restricted their use and prompted clinicians to seek alternative therapies (Weber, 2014).

Interleukins (ILs)

ILs are cytokines produced by subsets of T-cell lymphocytes, natural killer cells, and dendritic cells (cells that present antigens to the immune system). Similar to IFNs, ILs have immunomodulatory effects on other components of the immune response. IL-2 has been approved by the U.S. Food and Drug Administration (FDA) as a treatment option for renal cell cancer and metastatic melanoma in adults. However, because toxicities may be severe and life life-threatening, the role of ILs as cancer treatment has been limited (Weber, 2014).

Cancer Vaccines

Cancer vaccines mobilize the body's immune response to prevent or treat cancer. These vaccines contain either portions of cancer cells alone or portions of cells in combination with other substances (adjuvants) that can augment or boost immune responses. *Autologous* vaccines are made from the patient's own cancer cells, which are taken from tumor tissue obtained during biopsy or surgical intervention. The cancer cells are killed and prepared for injection back into the patient. *Allogeneic* vaccines are made from cancer cell lines that are immortalized cells that were originally obtained from other people who had a specific type of cancer. These cancer cells are grown in a laboratory and eventually killed and prepared for injection.

Prophylactic vaccines prevent disease. Three vaccines have been approved by the FDA for the prevention of HPV. HPV2 (Cervarix), recommended for use in females only, protects against HPV types 16 and 18 that are responsible for about 70% of all cervical cancers (ACS, 2015a). HPV4 (Gardasil) provides protection against four HPV types (6, 11, 16, and 18) and is recommended for use in both males and females. HPV9 (Gardasil-9), recommended for both males and females, protects against nine HPV types associated with cervical, anal, vaginal, and vulvar cancers. HPV9 also protects against genital warts. All of the HPV vaccines are given as a series of three doses over 6 months. Although the role of HPV vaccines in prevention of oropharyngeal cancers related to HPV 16 has not been fully established, there are preliminary data to suggest effectiveness (Herrero, Quint, Hildesheim, et al., 2015).

Therapeutic vaccines kill existing cancer cells and inhibit further cancer development. Sipuleucel-T is indicated for men with metastatic prostate cancer that is no longer responding to hormone therapy. It is the only therapeutic vaccine currently FDA approved. Therapeutic vaccines do not cure cancer but are associated with improved patient survival (Kannan, Madden, & Andrews, 2014).

Gene Therapy

Gene therapy includes approaches that correct genetic defects, manipulate genes to induce tumor cell destruction, or assist the body's immune defenses in the hope of preventing or combating disease. One of the challenges confronting cancer gene therapy is the multiple somatic mutations involved in the development of cancer, making it difficult to identify the most effective gene therapy approach.

Considerable advances have been made in the identification of effective tumor cell targets and evaluation of the most appropriate vectors. Vectors serve as a vehicle or carrier to transport a gene into the target cell. With improved understanding of cell surface proteins and signaling pathways, many clinical trials are under way.

At this time, there are no FDA-approved gene therapies for cancer. Three approaches have been used in the development of gene therapies, with adenoviruses showing the most promise in each:

- *Tumor-directed therapy* is the introduction of a therapeutic gene (suicide gene) into tumor cells in an attempt to destroy them. This approach is challenging because it is difficult to identify the gene that would cause optimal tumor destruction, and patients with widespread disease would require multiple injections to treat every site of disease.
- *Active immunotherapy* is the administration of genes that will invoke the antitumor responses of the immune system.
- *Adoptive immunotherapy* is the administration of genetically altered lymphocytes that are programmed to cause tumor destruction.

Nursing Management

Patients receiving targeted therapies have many of the same needs as patients undergoing other cancer treatments. However, manipulation and stimulation of the immune system create unique challenges. Consequently, the nurse must assess the need for education, support, and additional resources for both the patient and the family and assist in planning and evaluating patient care. Patient education is important, as many of the toxicities associated with targeted therapies are not only a source of physical discomfort, but they also impact the quality of life, and potentially impact patient adherence to oral drug regimens (Vioral, Leslie, Best, et al., 2014); (Yagasaki & Komatsu, 2013).

Monitoring Therapeutic and Adverse Effects

The nurse must become familiar with each agent given and its potential effects. Adverse effects such as fever, myalgia, nausea, and vomiting, as seen with IFN therapy, may not be life-threatening. Other adverse effects (e.g., capillary leak syndrome, pulmonary edema, hypotension) that may become life-threatening can occur with BRM approaches such as high-dose IL-2 therapy. MoAbs are associated with both common and unique adverse effects. Although mild to moderate infusion reactions are more commonly associated with chimeric MoAbs, severe HSRs have been seen with MoAb infusions. Nurses must be aware of the adverse effects of BRMs and recognize the signs and symptoms of serious reactions to emergently institute

appropriate interventions and supportive care. Nurses monitor patients for the impact of adverse effects on performance status and quality of life so that appropriate measures can be implemented to improve patient outcomes.

Promoting Home, Community-Based, and Transitional Care

The nurse educates patients about self-care and assists in providing for continuing care. Some targeted therapies can be given subcutaneously by the patient or family members at home. As needed, the home care nurse educates the patient and family how to administer these agents and monitors the use of appropriate technique as well as safe disposal of sharps and contaminated materials. The nurse also provides instructions about side effects and helps the patient and family identify strategies to manage many of the common side effects of BRM therapy, such as fatigue, anorexia, and flulike symptoms.

The use of oral medications to treat cancer has risen greatly in the past several years, especially with advances in targeted therapies, many of which are given by mouth. It has been estimated that almost half of the new antineoplastic drugs are oral agents (IMS, 2014). Of over 700 drugs in development, 80% are based on targeted approaches and about 35% are oral agents. The rising use of oral therapies shifts the responsibility for delivery of treatment to patients and families in the home setting. Treatment approaches with newer mechanisms of action and associated toxicities, as well as the transition of responsibility to patients and families, increase the need for nurses to identify factors affecting adherence and develop strategies to address adherence barriers (see Table 58-9).

The nurse collaborates with physicians, social workers, third-party payers, and pharmaceutical companies to help the patient obtain reimbursement or support for the cost of oral targeted

TABLE 58-9 Strategies for Promoting Adherence to Oral Antineoplastic Agents

Assess for factors that may interfere with adherence to oral antineoplastic agents; develop plan of care that addresses specific assessment findings.

Barriers to Adherence	Strategies for Promoting Adherence
Sociodemographic Factors	
• Limited financial resources • Competing priorities for financial resources • Joblessness • Limited or no insurance • Racial or ethnic disparities • Lower level of education • Poor health literacy • Illiteracy • Non–English speaking • Lack of transportation • Lack of or limited social support • Rural residence	• Refer to financial counseling through health care facility, local nonprofit health/oncology support/advocacy, or other nonprofit community advocacy organizations. • Refer to social worker for referrals as described above and/or for disability applications through employer. • Explore patient assistance programs for costs of health care, copays, medications, household costs, transportation services (costs or availability), and home care available through nonprofit organizations, oncology support/advocacy or other nonprofit community advocacy organizations, religious institutions, philanthropic organizations, pharmaceutical industry–sponsored programs, health care institution–specific programs; assist with financial documentation and application procedures as needed. • Explore assistance programs for other priorities competing for financial resources (i.e., for utility costs, gas, child care, food). • Assist patient to identify family, friends, or other available supports to assist with activities of daily living, household responsibilities, errands, shopping, meals, transportation or other responsibilities; assist with delegation of needs and schedules of availability if needed. • Assess preferred method of learning (i.e., verbal, visual, written materials); tailor instructional materials to patient needs, including language. • Include family, significant other, and friends in education whenever feasible. • Use return demonstration of behaviors and devices used to support adherence. • Provide contact information that spans 24 hours for questions or problems. • Contact patient by phone or other means (e-mail) to assess for concerns in between follow-up visits to physician. • Encourage patient to use adherence reminders, such as pill boxes, medication calendars, checklists, medication diaries, alarms on cell phone or other devices/timers; explore availability of programmed telephone reminder services, text messages from family member, friend, or other caregiver; review diary at each visit. • Instruct patient to bring pill bottles to each follow-up visit; perform pill counts to monitor adherence. • Send postcard reminder to patient weekly (or less often) or 1 week prior to due date for medication refill. • Refer to home care for continued education, and follow up on adherence. • Identify local pharmacies that supply oral cancer therapies. Instruct patients to contact nurse if the pharmacy cannot fill the prescription within 24 hours. • Remind patients to anticipate need for adequate supply of medications prior to travel or vacation.
Age	
• Older adults; especially those >75 years	• Ensure that printed education materials and instructions are printed in black using at least 14-point sans serif font such as Arial or Calibri. • Use illustrated education materials. • Review and revise adherence strategies if patient status declines or changes. • Explore availability of alarmed medication box.
Beliefs	
• Oral medications less effective or important than IV treatments • Fatalism about disease outcomes	• Provide education regarding oral versus IV medications. • Discuss goals of care and ongoing assessment of response to treatment.

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Comorbidities	
• Preexisting chronic disease • Vision or hearing impairments	• Communicate with primary care and other providers involved in care of patient regarding current cancer disease status and treatment; collaborate with other providers for ongoing management of nononcology issues or exacerbation of issues that may impact cancer treatment adherence. • Collaborate with appropriate resources to assist with special needs and assistive devices for vision or hearing impairments.
Polypharmacy	
• Multiple medications for comorbidities and/or cancer treatment and symptom management	• Review all medications prescribed by oncology physicians and other providers involved in care of patient for preexisting chronic disease. • Assess patient use of over-the-counter medications and other agents. • Consult with pharmacist to identify medications and other agents that may be contraindicated or that may interfere with antineoplastic regimen. • Collaborate with all providers prescribing medications in order to simplify and/or reduce number of required medications if possible. • Provide patient, family, or other caregiver education regarding specific instructions when multiple medications are required. • Provide written checklist for patient to utilize daily to check off each medication when taken. • Do not give patients prescriptions that allow for refills; prescriptions should be for a finite period of time that concludes with next scheduled visit.
Psychiatric, Psychological, or Cognitive Concerns	
• Psychiatric disease • Depression • Cognitive impairments • Anxiety	• Avoid initial education regarding oral medications at the same time of first physician visit; have patient and other learners return for another appointment to see nurse for education, and follow up with subsequent visit if deemed to be at high risk for adherence challenges. • Discuss with physician the necessity for referral to psychiatrist to evaluate need for psychotropic medications. • Refer patient for professional mental health counseling as needed. • Identify additional supports for care and education as discussed earlier.
Disease Factors	
• Symptoms such as pain, nausea, fatigue, skin rashes, etc. • Impaired mobility	• Proactively assess and manage symptoms related to underlying disease and/or treatments. • Provide patient, family, or other caregivers education about expected side effects and management strategies. • Instruct patient to premedicate with antiemetic as prescribed 30 minutes prior to taking oral antineoplastic agent if needed for nausea and/or vomiting. • Identify additional supports for care as discussed earlier. • Assess need for referral to home physical and/or occupational therapy to address impaired mobility and need for assistive devices.
Communication Issues	
• Patient–Clinician • Clinician—Clinician	• Establish rapport and allow patients, families, and other caregivers time and opportunity to ask questions. • Do not assume adherence to oral antineoplastic agents; assess potential barriers consistently throughout course of treatment at each follow-up visit. • Communicate with primary provider regarding current cancer disease status, treatment and information regarding antineoplastic agents, such as drug–drug interactions, expected toxicities, and toxicities requiring prompt intervention.

Adapted from Vioral, A., Leslie, M., Best, R., et al. (2014). Patient adherence with oral oncolytic therapies. Seminars in Oncology Nursing, 30(3), 190–199.

therapies and other required medications. The nurse also reminds the patient about the importance of keeping follow-up appointments with the physician and assesses the patient's need for symptom management related to the underlying diseases and/or adverse effects of treatment. Home care nurses maintain communication with the physician regarding patient adherence and tolerance of treatment so that changes in care can be implemented in a timely fashion.

Complementary, Alternative, and Integrative Health Therapies

Integrative healthcare is viewed as a comprehensive, interdisciplinary approach to preventing and treating illness and promoting health that brings together complementary, alternative, and conventional therapies. The use of an integrative approach to health wellness has grown within mainstream healthcare settings, particularly within oncology care (National Center for Complementary and Integrative Health [NCCIH], 2015).

Individuals use complementary approaches to prevent and treat cancer, although there are no data to support efficacy. Patients also use complementary approaches to manage symptoms related to cancer and associated treatments; some approaches are supported by clinical research while others are not. The NCCIH suggests that as many as 65% of people diagnosed with cancer have used some form of complementary medicine. The use of complementary strategies is influenced by age, race, ethnicity, and geography (Clarke, Black, Stussman, et al., 2015). However, patients do not routinely communicate complementary practices to their health care providers because they usually are not asked about its use; they withhold the information, fearing that their physicians would not approve,

or they feel that the use of these approaches will not affect the conventional treatment they are receiving

Although many complementary modalities can be a source of comfort and emotional support for patients, assessment of complementary therapy use is important for patient safety. Patients often perceive vitamins and dietary supplements as harmless, natural products that have no side effects or potential toxicities. In patients receiving any conventional therapies, the use of herbs or botanicals may interfere with drug metabolism, decrease or increase desired effects, or contain elements of uncertain pharmacologic capacities (NCCIH, 2015). Deep tissue massage and other manipulative therapies are contraindicated in patients with open wounds, radiation dermatitis, thrombocytopenia, VTE, and coagulation disorders, and in those taking anticoagulants.

Nursing Care of Patients with Cancer

The outlook for patients with cancer has greatly improved because of scientific and technologic advances. However, as a result of the underlying disease or various treatment modalities, patients with cancer may experience a variety of secondary problems such as reduced WBC counts, infection, bleeding, skin and nutritional problems, pain, fatigue, and psychological stress. Chart 58-7 provides a nursing care plan for patients with cancer.

Maintaining Tissue Integrity

Some of the most frequently encountered disturbances of tissue integrity include stomatitis, skin and tissue reactions to radiation therapy, cutaneous toxicities associated with targeted therapy, alopecia, and metastatic skin lesions.

Stomatitis

Mucositis, a common side effect of radiation and some types of chemotherapy, refers to an inflammatory process involving the mucous membranes of the oral cavity and the gastrointestinal tract. **Stomatitis,** a form of mucositis, is an inflammatory process of the mouth, including the mucosa and tissues surrounding the teeth. Stomatitis is characterized by changes in sensation, mild redness (erythema), and edema or, if severe, by painful ulcerations, bleeding, and secondary infection. Stomatitis commonly develops 5 to 14 days after patients receive certain chemotherapeutic agents, such as doxorubicin and 5-fluorouracil; immunotherapies, such as IL-2 and IFN; and molecular targeted drugs, such as temsirolimus and everolimus. Stomatitis affects up to 100% of patients undergoing high-dose chemotherapy with HSCT, 80% of patients with malignancies of the head and neck receiving radiotherapy, and up to 40% of patients receiving standard-dose chemotherapy (Gibson, Keefe, Lalla, et al., 2013). Stomatitis may be worse in patients with head and neck cancers who receive combined modality therapy of both radiation and chemotherapy. When severe, stomatitis can lead to interruptions, delays, and modifications in the course of treatment, all of which may contribute to less desirable patient outcomes. Severe oral pain can significantly affect swallowing, nutritional intake, speech, quality of life, coping abilities, and willingness to adhere to treatment regimens. In addition, stomatitis may lead to more frequent health care visits, hospitalizations, and increased health care costs (Eilers, Harris, Henry, et al., 2014). Stomatitis and mucositis are attributed to a cascade of molecular processes and submucosal endothelial cell destruction that begin almost immediately after the initiation of radiation and certain types of chemotherapy, prior to the development of signs and symptoms. Mucositis develops as a consequence of a sequence of related and interacting biologic events, culminating in injury and apoptosis of basal epithelial cells, leading to the loss of epithelial renewal, atrophy, and ulceration. Gram-positive and gram-negative organisms can invade the ulcerated tissue and result in infection.

Nursing assessment begins with an understanding of the patient's usual practices for oral hygiene and identification of individuals at risk for stomatitis. Oral cavity assessment is performed daily or at each patient visit (Tipian, 2014). Risk factors and comorbidities associated with stomatitis include poor oral hygiene, general debilitation, existing dental disease, prior irradiation to the head and neck region, impaired salivary gland function, the use of other medications that dry mucous membranes, myelosuppression (bone marrow depression), advanced age, tobacco use, previous stomatoxic chemotherapy, diminished renal function, and impaired nutritional status (Eilers et al., 2014). The patient is also assessed for dehydration, infection, pain, and nutritional impairment resulting from mucositis.

Optimal evidence-based prevention and treatment approaches for stomatitis remain limited but continue to be studied across disciplines (Eilers et al., 2014). Most clinicians agree that maintenance of good oral hygiene, including brushing, flossing, rinsing, and dental care, is necessary to minimize the risk of oral complications associated with cancer therapies.

Palifermin (Kepivance), an IV-administered synthetic form of human keratinocyte growth factor, is beneficial in the prevention of stomatitis in patients with hematologic malignancies who are preparing for HSCT (Vadhan-Raj, Goldberg, Perales, et al., 2013). Palifermin promotes epithelial cell repair and accelerated replacement of cells in the mouth and gastrointestinal tract. Careful timing of administration and monitoring are essential for effectiveness and to detect adverse effects. Other approaches recommended for practice include cryotherapy (topical application of oral ice during infusions), consistent oral hygiene, low-level laser therapy, and sodium bicarbonate mouth rinses (Eilers et al., 2014); (Tayyem, 2014). Additional aspects of care are discussed in Chart 58-7: Nursing care plan for patients with cancer.

Radiation-Associated Impairment of Skin Integrity

Although advances in radiation therapy have resulted in decreased incidence and severity of skin impairments, patients may still develop radiation dermatitis associated with pain, irritation, pruritus, burning, skin sloughing without drainage (dry desquamation) or with drainage (wet desquamation), and diminished quality of life. Nursing care for patients with radiation dermatitis includes maintenance of skin integrity, cleansing, promotion of comfort, pain reduction, prevention of additional trauma, prevention and management of infection, and promotion of a moist wound-healing environment (Fogh & Yom, 2014). In order to prevent impaired skin integrity, patients are advised to use moisturizer on the skin, avoid sun exposure to the area of treatment, and avoid tape or bandages and other sources of irritation or trauma. Although a variety of methods and products are used in clinical practice for patients with radiation-induced skin impairment, there is limited evidence to support their value. Patients with skin and tissue reactions to radiation therapy require careful skin care to prevent further skin irritation, drying, and damage, as discussed in the nursing care plan

Chart 58-7 PLAN OF NURSING CARE

The Patient with Cancer

Nursing Diagnosis: Risk for infection related to inadequate defenses related to myelosuppression secondary to radiation or antineoplastic agents

Goal: Prevention of infection

Nursing Interventions	Rationale	Expected Outcomes
1. Assess patient for evidence of infection. a. Check vital signs every 4 hours. b. Monitor white blood cell (WBC) count and differential each day. c. Inspect all sites that may serve as entry ports for pathogens (IV sites, wounds, skin folds, bony prominences, perineum, and oral cavity).	1. Signs and symptoms of infection may be diminished in the immunocompromised host. Prompt recognition of infection and subsequent initiation of therapy will reduce morbidity and mortality associated with infection.	• Demonstrates normal temperature and vital signs • Exhibits absence of signs of inflammation: local edema, erythema, pain, and warmth • Exhibits normal breath sounds on auscultation • Takes deep breaths and coughs every 2 hours to prevent respiratory dysfunction and infection.
2. Report fever (≥38.3°C [101°F] or ≥38°C [100.4°F] for >1 hour) (see Table 58-11), chills, diaphoresis, swelling, heat, pain, erythema, exudate on any body surfaces. Also report change in respiratory or mental status, urinary frequency or burning, malaise, myalgias, arthralgias, rash, or diarrhea.	2. Early detection of infection facilitates early intervention.	• Exhibits absence of pathogens on cultures • Avoids contact with others with infections • Avoids crowds • All personnel carry out hand hygiene after each voiding and bowel movement. • Excoriation and trauma of skin are avoided. • Trauma to mucous membranes is avoided (avoidance of rectal thermometers, suppositories, vaginal tampons, perianal trauma).
3. Obtain cultures and sensitivities as indicated before initiation of antimicrobial treatment (wound exudate, sputum, urine, stool, blood).	3. Tests identify the organism and indicate the most appropriate antimicrobial therapy. The use of inappropriate antibiotics enhances proliferation of additional flora and encourages growth of antibiotic-resistant organisms.	• Uses evidence-based procedures and techniques if participating in management of invasive lines or catheters • Uses electric razor • Is free of skin breakdown and stasis of secretions • Adheres to dietary and environmental precautions • Exhibits no signs of sepsis or septic shock • Exhibits normal vital signs, cardiac output, and arterial pressures when monitored • Demonstrates ability to administer colony-stimulating factor • Has bowel movements at regular intervals without constipation or straining • Patient hygiene is maintained. • Absence of IV catheter–related infection • Absence of skin abscesses • Absence of urinary catheter–related infection
4. Initiate measures to minimize infection. a. Discuss with patient and family: 1. Placing patient in private room if absolute WBC count <1000/mm^3. 2. Importance of patient avoiding contact with people who have known or recent infection or recent vaccination.	4. Exposure to infection is reduced. a. Preventing contact with pathogens helps prevent infection.	
b. Instruct all personnel in careful hand hygiene before and after entering room.	b. Hands are significant source of contamination.	
c. Avoid rectal or vaginal procedures (rectal temperatures, examinations, suppositories; vaginal tampons).	c. Incidence of rectal and perianal abscesses and subsequent systemic infection is high. Manipulation may cause disruption of membrane integrity and enhance progression of infection.	
d. Use stool softeners to prevent constipation and straining.	d. Minimizes trauma to tissues	
e. Assist patient in practice of meticulous personal hygiene.	e. Prevents skin irritation	
f. Instruct patient to use electric razor.	f. Minimizes skin trauma	
g. Encourage patient to ambulate in room unless contraindicated.	g. Minimizes chance of skin breakdown and stasis of pulmonary secretions	
h. Provide patient and family education on food hygiene and safe food handling.	h. No evidence supports dietary restrictions of avoiding raw or fresh fruit and vegetables for patients who are neutropenic. General precautions regarding food handling and storage are recommended.	

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i. Each day, change water pitcher, denture cleaning fluids, and respiratory equipment containing water.	i. Stagnant water is a source of infection.
5. Assess IV sites every day for evidence of infection. a. Change peripheral short-term IV sites every other day. b. Cleanse skin with povidone–iodine before arterial puncture or venipuncture. c. Change central venous catheter dressings every 48 hours. d. Change all solutions and infusion sets every 72–96 hours. e. Follow Infusion Nursing Society guidelines for care of peripheral and central venous access devices.	5. Nosocomial staphylococcal septicemia is closely associated with IV catheters. a. Incidence of infection is increased when catheter is in place >72 hours. b. Povidone–iodine is effective against many gram-positive and gram-negative pathogens. c. Allows observation of site and removes source of contamination d. Once introduced into the system, microorganisms are capable of growing in infusion sets despite replacement of container and high flow rates. e. Infusion Nursing Society collaborates with other nursing subspecialties in determining guidelines for IV access care.
6. Avoid intramuscular injections.	6. Reduces risk for skin abscesses.
7. Avoid insertion of urinary catheters; if catheters are necessary, use aseptic technique.	7. Rates of infection greatly increase after urinary catheterization.
8. Educate patient or family member to administer granulocyte (or granulocyte-macrophage) colony-stimulating factor when prescribed.	8. Granulocyte colony-stimulating factor decreases the duration of neutropenia and the potential for infection.
9. Advise patient to avoid exposure to animal excreta, discuss dental procedures with primary provider, avoid vaginal douche, and avoid vaginal or rectal manipulation during sexual contact during the period of neutropenia.	9. Minimizes exposure to potential sources of infection and disruption of skin integrity.

Nursing Diagnosis: Risk for impaired skin integrity: erythematous and wet desquamation reactions to radiation therapy
Goal: Maintenance of skin integrity

Nursing Intervention	Rationale	Expected Outcomes
1. In erythematous areas: a. Avoid the use of soaps, cosmetics, perfumes, powders, lotions, and ointments; non–aluminum-based deodorant may be used on intact skin. b. Use only lukewarm water to bathe the area. c. Avoid rubbing or scratching the area. d. Avoid shaving the area with a straight-edged razor.	1. Care to the affected areas must focus on preventing further skin irritation, drying, and damage. a. These substances may cause pain and additional skin irritation and damage. b. Avoiding water of extreme temperatures and soap minimizes additional skin damage, irritation, and pain. c. Rubbing, scratching, or both will lead to additional skin irritation, damage, and increased risk of infection. d. The use of razors may lead to additional irritation and disruption of skin integrity and increased risk of infection.	• Avoids use of soaps, powders, and other cosmetics on site of radiation therapy • States rationale for special care of skin • Exhibits minimal change in skin • Avoids trauma to affected skin region (avoids shaving, constricting and irritating clothing, extremes of temperature, and the use of adhesive tape) • Reports change in skin promptly • Demonstrates proper care of blistered or open areas • Exhibits absence of infection of blistered and opened areas. • Wound is free of development of eschar.

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e. Avoid applying hot-water bottles, heating pads, ice, and adhesive tape to the area.	e. Avoiding extreme temperatures minimizes additional skin damage, irritation, burns, and pain.
f. Avoid exposing the area to sunlight or cold weather.	f. Sun exposure or extreme cold weather may lead to additional skin damage and pain.
g. Avoid tight clothing in the area. Use cotton clothing.	g. Allows air circulation to affected area
h. Topical agents such as Aquaphor, Radiacare gel, aloe vera, or Biafine (Valeant may be used, and low- or medium-potency corticosteroid cream may be given if pruritus is present.)	h. May aid healing; however, evidence supporting the benefits of topical agents is lacking.
2. If wet desquamation occurs:	2. Open weeping areas are susceptible to bacterial infection. Care must be taken to prevent introduction of pathogens.
a. Do not disrupt any blisters that have formed.	a. Disruption of skin blisters disrupts skin integrity and may lead to increased risk of infection.
b. Avoid frequent washing of the area.	b. Frequent washing may lead to increased irritation and skin damage, with increased risk of infection.
c. Report any blistering.	c. Blistering of skin represents progression of skin damage.
d. Use *prescribed* creams or ointments; topical antibacterial creams may help to dry a wet wound (e.g., Silvadene cream)	d. Anecdotally believed to decrease irritation and inflammation of the area and promote healing; although a variety of products are used in many settings, there are few randomized controlled trials with evidence to support one product or intervention over another.
e. If area weeps, apply a nonadhesive absorbent dressing.	e. Easier to remove and associated with less pain and trauma when drainage dries and adheres to dressing.
f. If the area is without drainage, moisture and vapor-permeable dressings, such as hydrocolloids and hydrogels on noninfected areas, have been used in many settings.	f. May promote healing; however, randomized controlled clinical trial support is lacking in the setting of moist desquamation. Hydrocolloid dressings may enhance comfort.
g. Consult with wound-ostomy-continence nurse (WOCN) and primary provider if eschar forms.	g. Eschar must be removed to promote healing and prevent infection. WOCNs have expertise in the care of wounds.

Nursing Diagnosis: Impaired oral mucous membrane: stomatitis
Goal: Maintenance of intact oral mucous membranes

Nursing Intervention	Rationale	Expected Outcomes
1. Assess oral cavity daily using the same assessment criteria or rating scale.	1. Provides baseline for later evaluation; maintains consistency in assessment findings	• States rationale for frequent oral assessment and hygiene
2. Identify individuals at increased risk for stomatitis and related complications.	2. Patient and treatment variables are associated with the incidence and severity of stomatitis as well as related complications such as delayed healing and infection.	• Factors associated with the incidence, severity, and complications are identified prior to initiation of cancer treatment • Oral mucosal assessment is conducted at baseline and on an ongoing basis. • Oral hygiene practices are initiated prior to development of stomatitis.

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3. Instruct patient to report oral burning, pain, areas of redness, open lesions on oropharyngeal mucosa and lips, pain associated with swallowing, or decreased tolerance to temperature extremes of food.	3. Identification of initial stages of stomatitis will facilitate prompt interventions, including modification of treatment as prescribed by primary provider.	• Identifies signs and symptoms of stomatitis to report to nurse or primary provider • Participates in recommended oral hygiene regimen • Avoids mouthwashes with alcohol • Brushes teeth and mouth with soft toothbrush • Uses lubricant to keep lips soft and nonirritated • Avoids hard-to-chew, spicy, hot foods or other irritating foods • Maintains adequate hydration
4. Encourage and assist as needed in oral hygiene.	4. Patients who are having discomfort or pain, or other symptoms related to the disease and treatment, may require encouragement and assistance in performing oral hygiene. Oral hygiene is maintained to prevent complications of stomatitis, such as infection.	
Preventive		
1. Advise patient to avoid irritants such as commercial mouthwashes, alcoholic beverages, and tobacco.	1. Alcohol content of mouthwashes and tobacco smoke will dry oral tissues and potentiate breakdown.	• Exhibits clean, intact oral mucosa • Exhibits no ulcerations or infections of oral cavity • Exhibits no evidence of bleeding • Reports absent or decreased oral pain • Reports no difficulty swallowing • Exhibits healing (reepithelialization) of oral mucosa within 5–7 days (mild stomatitis)
2. Brush with soft toothbrush using nonabrasive toothpaste for 90 seconds after meals and at bedtime; allow toothbrush to air dry before storing; floss at least once daily or as advised by the clinician; patients who have not previously flossed regularly should not initiate flossing during stomatotoxic treatment; rinse mouth four times a day with a bland rinse (normal saline, sodium bicarbonate, or saline and sodium bicarbonate); avoid irritating foods (acidic, hot, rough, and spicy); use water-based moisturizers to protect lips.	2. Limits trauma and removes debris. Patients who have not previously flossed regularly do initiate flossing during stomatoxic treatment due to potential for injury to the oral mucosa and increased susceptibility to infection.	
3. Consider use of oral ice chips during stomatoxic chemotherapy infusions.	3. Oral cryotherapy has demonstrated reduced oral mucositis incidence, severity, and pain; improved quality of life; and minimizes chances of complications of oral mucositis	
4. Consider use of low level laser therapy.	4. Low energy level laser therapy has demonstrated decreased severity, duration, and pain associated with stomatitis.	
5. Consider administration of Palifermin as prescribed for patients receiving high-dose chemotherapy.	5. Palifermin, a recombinant keratinocyte growth factor (KGF) that stimulates the growth of cells lining the mouth and intestinal tract, has been shown to decrease the severity and duration of stomatitis.	
6. Maintain adequate hydration.	6. Maintenance of hydration prevents mucosal drying and breakdown.	
7. Provide written instruction and education to patients on the above items.	7. Written information reinforces patient education and provides the patient and family with a source.	
Mild stomatitis (generalized erythema, limited ulcerations, small white patches: *Candida*)		
1. Use normal saline mouth rinses every 1–4 hours.	1. Assists in removing debris, thick secretions, and bacteria	• Exhibits healing of oral tissues within 10–14 days (severe stomatitis) • Exhibits no bleeding or oral ulceration • Consumes adequate fluid and food • Exhibits absence of dehydration and weight loss • Exhibits no evidence of infection
2. Use soft toothbrush or toothette.	2. Minimizes trauma	
3. Remove dentures except for meals; be certain that dentures fit well.	3. Minimizes friction and discomfort	
4. Apply water-soluble lip lubricant.	4. Promotes comfort	
5. Avoid foods that are spicy or hard to chew and those with extremes of temperature.	5. Prevents local trauma	

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Severe stomatitis (confluent ulcerations with bleeding and white patches covering >25% of oral mucosa)		
1. Obtain tissue samples for culture and sensitivity tests of areas of infection.	1. Assists in identifying need for antimicrobial therapy	a. Adheres to oral care regimen b. Exhibits healing of oral tissues within 10–14 days (severe stomatitis) • Consumes adequate fluid and food • Exhibits absence of dehydration and weight loss • Exhibits no evidence of infection • Reports absent or decreased discomfort or pain
2. Assess ability to chew and swallow; assess gag reflex.	2. Patient may be in danger of aspiration	
3. Use oral rinses (may combine in solution saline, anti-*Candida* agent, such as Mycostatin, and topical anesthetic agent [described later]) as prescribed, or place patient on side and irrigate mouth; have suction available.	3. Facilitates cleansing and provides for safety and comfort	
4. Remove dentures.	4. Prevents trauma from ill-fitting dentures	
5. Use toothette or gauze soaked with solution for cleansing.	5. Limits trauma and promotes comfort	
6. Use water-soluble lip lubricant.	6. Promotes comfort and minimizes loss of skin integrity	
7. Provide liquid or pureed diet.	7. Ensures intake of easily digestible foods without chewing	
8. Monitor for dehydration.	8. Decreased oral intake and ulcerations potentiate fluid deficits.	
9. Minimize discomfort.		
a. Consult primary provider for use of topical anesthetic, such as dyclonine and diphenhydramine, or viscous lidocaine.	a. Alleviates pain and increases sense of well-being; promotes participation in oral hygiene and nutritional intake	
b. Administer systemic analgesics as prescribed.	b. Adequate management of pain related to severe stomatitis can facilitate improved quality of life, participation in other aspects of activities of daily living, oral intake, and verbal communication.	
c. Perform mouth care as described.	c. Promotes removal of debris, healing, and comfort	

Nursing Diagnosis: Impairment of skin integrity related to rash
Goals: Maintenance of skin integrity

Nursing Intervention	Rationale	Expected Outcomes
Prevention		
1. Instruct patients to avoid sunlight through use of protective clothing, use of sun screen with SPF of 30 with physical blockers (zinc oxide, titanium dioxide), or avoidance of direct sun exposure.	1. Many agents are associated with photosensitivity; sunburn would intensify inflammation associated with rash and potentiate loss of skin integrity	• Sun exposure will be limited; no development of sun burn • Absence of dehydration • Participates in skin care regimen as instructed
2. Maintain adequate oral hydration.	2. Prevents skin dryness related to dehydration	• Absence of dryness, flaking
3. Avoid long hot showers or baths, harsh soaps and laundry detergents, perfumes, and non-hypoallergenic cosmetics.	3. Prevents skin irritation, dryness, flaking, and inflammation	
4. Apply emollients; apply hydrocortisone 1% cream with moisturizer at least twice daily; administer doxycycline 100 mg twice per day or minocycline, as prescribed	4. Minimizes dryness, flaking, and disruption of skin integrity.	
Treatment		
1. Apply topical treatment as prescribed: clindamycin 1%, fluocinonide 0.05% cream twice a day, or alclometasone 0.05% cream twice a day	1. Recommended as treatment to minimize skin disruption and prevent infection by Multinational Association of Supportive Care in Cancer (MSACC)	• Rash severity does not interfere with level of comfort and adherence to targeted therapy as prescribed; absence of local or systemic infection

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2. For severe papulopustular rash: Administer systemic treatment as prescribed: doxycycline 100 mg twice per day; minocycline 100 mg daily; or isotretinoin at low doses of 20–30 mg per day	2. Recommended as treatment to minimize skin disruption and prevent infection by Multinational Association of Supportive Care in Cancer (MSACC)	• Rash severity does not interfere with level of comfort and adherence to targeted therapy as prescribed; absence of local or systemic infection • Local infection is controlled; absence of bacteremia and sepsis
3. Assess for development of infection: obtain cultures of pustules and administer appropriate antibiotics as prescribed by the physician	3. Prompt recognition and treatment of infection are necessary to prevent bacteremia, sepsis, and further patient compromise	

Nursing Diagnosis: Impaired tissue integrity: alopecia
Goal: Maintenance of tissue integrity; coping with hair loss

Nursing Intervention	Rationale	Expected Outcomes
1. Discuss potential hair loss and regrowth with patient and family; advise that hair loss may occur on body parts other than the head.	1. Provides information so that patient and family can begin to prepare cognitively and emotionally for loss	• Identifies alopecia as potential side effect of treatment • Identifies positive and negative feelings and threats to self-image • Verbalizes meaning that hair and possible hair loss have for him or her • States rationale for modifications in hair care and treatment • Uses mild shampoo and conditioner, and shampoos hair only when necessary • Avoids hair dryer, curlers, sprays, and other stresses on hair and scalp • Wears hat or scarf over hair when exposed to sun • Takes steps to deal with possible hair loss before it occurs; purchases wig or hairpiece if desired • Maintains hygiene and grooming • Interacts and socializes with others
2. Explore potential impact of hair loss on self-image, interpersonal relationships, and sexuality.	2. Facilitates coping and maintenance of interpersonal relationships	
3. Prevent or minimize hair loss through the following:	3. Retains hair as long as possible.	
a. Use scalp hypothermia and scalp tourniquets, if appropriate.	a. Decreases hair follicle uptake of chemotherapy (not used for patients with leukemia or lymphoma because tumor cells may be present in blood vessels or scalp tissue)	
b. Cut long hair before treatment.	b. Minimizes hair loss due to the weight and manipulation of hair	
c. Use mild shampoo and conditioner, gently pat dry, and avoid excessive shampooing.		
d. Avoid electric curlers, curling irons, dryers, clips, barrettes, hair sprays, hair dyes, and permanent waves.		
e. Avoid excessive combing or brushing; use wide-toothed comb.		
4. Prevent trauma to scalp.	4. Preserves tissue integrity	
a. Lubricate scalp with vitamin A and D ointment to decrease itching.	a. Assists in maintaining skin integrity	
b. Use sunscreen or wear hat when in the sun.	b. Prevents ultraviolet light exposure	
5. Suggest ways to assist in coping with hair loss.	5. Minimizes change in appearance	
a. Purchase wig or hairpiece before hair loss.	a. Wig that closely resembles hair color and style is more easily selected if hair loss has not begun.	
b. If hair loss has occurred, take photograph to wig shop to assist in selection.	b. Facilitates adjustment	
c. Begin to wear wig before hair loss.	c. Enables patient to be prepared for loss and facilitates adjustment	
d. Wear hat, scarf, or turban.	d. Conceals loss and protects scalp	
6. Encourage patient to wear own clothes and retain social contacts.	6. Assists in maintaining personal identity	

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7. Explain that hair growth usually begins again once therapy is completed.	7. Reassures patient that hair loss is usually temporary

Nursing Diagnosis: Imbalanced nutrition: less than body requirements, related to nausea and vomiting
Goal: Patient experiences less nausea and vomiting associated with chemotherapy; weight loss is minimized

Nursing Intervention	Rationale	Expected Outcomes
1. Assess the patient's previous experiences and expectations of nausea and vomiting, including causes and interventions used.	1. Identifies patient concerns, misinformation, and potential strategies for intervention; also gives patient sense of empowerment and control	• Identifies previous triggers of nausea and vomiting • Exhibits decreased apprehension and anxiety • Identifies previously used successful interventions for nausea and vomiting • Reports decrease in nausea • Reports decrease in incidence of vomiting • Consumes adequate fluid and food when nausea subsides • Demonstrates use of distraction, relaxation, and imagery when indicated • Exhibits normal skin turgor and moist mucous membranes • No additional weight loss
2. Adjust diet before and after drug administration according to patient preference and tolerance.	2. Each patient responds differently to food after chemotherapy. A diet containing foods that relieve or prevent nausea or vomiting is most helpful.	
3. Prevent unpleasant sights, odors, and sounds in the environment.	3. Unpleasant sensations can stimulate the nausea and vomiting center.	
4. Use distraction, music therapy, biofeedback, self-hypnosis, relaxation techniques, and guided imagery before, during, and after chemotherapy.	4. Decreases anxiety, which can contribute to nausea and vomiting. Psychological conditioning may also be decreased.	
5. Administer prescribed antiemetics, sedatives, and corticosteroids before chemotherapy and afterward as needed.	5. Administration of antiemetic regimen before onset of nausea and vomiting limits the adverse experience and facilitates control. Combination drug therapy reduces nausea and vomiting through various triggering mechanisms.	
6. Ensure adequate fluid hydration before, during, and after drug administration; assess intake and output.	6. Adequate fluid volume dilutes drug levels, decreasing stimulation of vomiting receptors.	
7. Encourage frequent oral hygiene.	7. Reduces unpleasant taste sensations	
8. Provide pain-relief measures, if necessary.	8. Increased comfort increases physical tolerance of symptoms.	
9. Consult with dietician as needed.	9. Interdisciplinary collaboration is essential in addressing complex patient needs.	
10. Assess and address other contributing factors to nausea and vomiting, such as other symptoms, constipation, gastrointestinal irritation, electrolyte imbalance, radiation therapy, medications, and central nervous system metastasis.	10. Multiple factors may contribute to nausea and vomiting.	

Nursing Diagnosis: Imbalanced nutrition: less than body requirements, related to anorexia, cachexia, or malabsorption
Goal: Maintenance of nutritional status and of weight within 10% of pretreatment weight

Nursing Intervention	Rationale	Expected Outcomes
1. Assess and address factors that interfere with oral intake or are associated with increased risk of decreased nutritional status.	1. Multiple patient or treatment-related factors are associated with increased risk of impaired nutritional intake, such as radiation to the head, neck, and thorax; stomatoxic or emetogenic chemotherapy; prior oral, head, and neck surgery; mucositis; impaired swallowing or dysphagia; poor dentition; cough or shortness of breath.	• Factors associated with increased risk for impaired nutritional intake are identified. • Factors associated with increased risk of impaired nutritional intake are identified and addressed, whenever possible, through interdisciplinary collaboration. • Patient and family identify minimal nutritional requirements • Maintains or increases weight and body cell mass as per goals identified by nutritionist

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2. Initiate appropriate referrals for interdisciplinary collaboration to manage factors that interfere with oral intake.	2. Other disciplines may be more appropriate for assessment and management of issues such as swallowing impairments (speech therapy), fatigue and decreased physical ability (physical and occupational therapy), nutritional assessment and determination of patient needs (nutritionist), cough and shortness of breath (respiratory therapy), poor dentition (dental medicine), depression/anxiety (social worker, psychologist, or psychiatrist).	• Reports decreasing anorexia and increased interest in eating • Demonstrates normal skin turgor • Identifies rationale for dietary modifications; patient and family verbalize strategies to minimize nutritional deficits • Participates in calorie counts and diet histories • Uses relaxation techniques and guided imagery before meals • Exhibits laboratory and clinical findings indicative of adequate nutritional intake: normal serum levels of protein, albumin, transferrin, iron, blood urea nitrogen (BUN), creatinine, vitamin D, electrolytes, hemoglobin, hematocrit, and lymphocytes; normal urinary creatinine levels • Consumes diet containing required nutrients • Carries out oral hygiene before meals • Reports decreased pain and/or other symptoms; symptoms do not interfere with oral intake • Reports decreasing episodes of nausea and vomiting • Participates in increasing levels of activity as measured by assessment of performance status • Family and friends do not focus efforts on encouraging food intake • States rationale for use of tube feedings or parenteral nutrition • Demonstrates ability to manage enteral feedings or parenteral nutrition, if prescribed • Maintains body position and alignment needed to facilitate chewing and swallowing
3. Educate patient to avoid unpleasant sights, odors, and sounds in the environment during mealtime.	3. Anorexia can be stimulated or increased with noxious stimuli.	
4. Suggest foods that are preferred and well tolerated by the patient, preferably high-calorie and high-protein foods. Respect ethnic and cultural food preferences.	4. Foods preferred, well tolerated, and high in calories and protein maintain nutritional status during periods of increased metabolic demand.	
5. Encourage adequate fluid intake, but limit fluids at mealtime.	5. Fluids are necessary to eliminate wastes and prevent dehydration. Increased fluids with meals can lead to early satiety.	
6. Suggest smaller, more frequent meals.	6. Smaller, more frequent meals are better tolerated because early satiety is less likely to occur.	
7. Promote relaxed, quiet environment during mealtime with increased social interaction as desired.	7. A quiet environment promotes relaxation. Social interaction at mealtime may foster appetite, divert focus on food, and promote enjoyment of eating.	
8. If patient desires, serve wine at mealtime with foods.	8. Wine may stimulate appetite and add calories.	
9. Consider cold foods, if desired.	9. Cold, high-protein foods are often more tolerable and less odorous than hot foods.	
10. Encourage nutritional supplements and high-protein foods between meals.	10. Supplements and snacks add protein and calories to meet nutritional requirements.	
11. Encourage frequent oral hygiene, particularly prior to meals.	11. Oral hygiene may stimulate appetite and increase saliva production.	
12. Address pain and other symptom management needs.	12. Pain and other symptoms impair appetite and nutritional intake.	
13. Increase activity level as tolerated.	13. Increased activity promotes appetite.	
14. Decrease anxiety by encouraging verbalization of fears and concerns; use relaxation techniques and guided imagery at mealtime.	14. Relief of anxiety may increase appetite.	
15. Instruct patient and family about body alignment and proper positioning at mealtime.	15. Proper body position and alignment are necessary to aid chewing and swallowing.	
16. Collaborate with dietician to provide nutritional counseling; instruct patient and family regarding enteral tube feedings of commercial liquid diets, elemental diets, or other foods as prescribed.	16. Nutritional counseling may improve outcomes. Tube feedings may be necessary in the severely debilitated patient who has a functioning gastrointestinal system but is unable to maintain adequate oral intake.	

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17. Collaborate with dietician or nutrition support team to instruct patient and family regarding home parenteral nutrition with lipid supplements as prescribed.	17. Parenteral nutrition with supplemental fats supplies needed calories and proteins to meet nutritional demands, especially in the nonfunctional gastrointestinal system.	
18. Administer appetite stimulants as prescribed by primary provider.	18. Although the mechanism is unclear, medications such as megestrol acetate (Megace) have been noted to improve appetite in patients with cancer and human immunodeficiency virus infection.	
19. Encourage family and friends not to nag or cajole patient about eating.	19. Pressuring patient to eat may cause conflict and unnecessary stress.	
20. Assess and address other contributing factors to nausea, vomiting, and anorexia such as electrolyte imbalance, radiation therapy, medications, and central nervous system metastasis.	20. Multiple factors contribute to anorexia and nausea.	

Nursing Diagnosis: Fatigue
Goal: Decreased fatigue level

Nursing Intervention	Rationale	Expected Outcomes
1. Assess patient and treatment factors that are associated with or increase fatigue (e.g., anemia, fluid and electrolyte imbalances, pain, anxiety, etc.)	1. Multiple factors are associated with or contribute to cancer-related fatigue. Although fatigue is common in patients receiving chemotherapy or radiation therapy, there are several factors that can be modified or addressed, such as dehydration, electrolyte abnormalities, organ impairment, anemia, impaired nutrition, pain and other symptoms, depression, anxiety, impaired mobility, and shortness of breath.	• Factors contributing to fatigue are assessed and managed whenever possible. • Exhibits acceptable serum value levels for nutritional indices (See Imbalanced Nutrition) • Reports decreased pain and/or other symptoms • Consumes diet with recommended nutritional intake • Achieves or maintains appropriate weight and body mass • Maintains adequate hydration • Reports decreasing levels of fatigue • Adopts healthy lifestyle practices • Rests when fatigued • Reports adequate sleep • Requests assistance with activities appropriately • Uses relaxation exercises and imagery to decrease anxiety and promote rest • Reports no breathlessness during activities • Reports improved ability to relax and rest • Exhibits improved mobility and decreased fatigue Fatigue does not interfere with ability to participate in activities of daily living or pleasure
2. Institute interventions to address factors contributing to fatigue (e.g., correct electrolyte imbalance, manage pain, collaborative management of anemia, administer prescribed antidepressants, anxiolytics, hypnotics, or psychostimulants, as indicated)	2. Addressing factors contributing to fatigue assists in managing fatigue (i.e., lowered hemoglobin and hematocrit predispose patient to fatigue due to decreased oxygen availability especially in a setting of impaired mobility that requires increased energy expenditure).	
3. Encourage balance of rest and exercise; avoiding extended periods of inactivity. At minimum, promote patient's normal sleep habits.	3. Sleep helps to restore energy levels. Prolonged napping during the day may interfere with sleep habits.	
4. During active treatment, rearrange daily schedule and organize activities to conserve energy expenditure; encourage patient to ask for others' assistance with necessary chores, such as housework, child care, shopping, and cooking. During periods of profound fatigue, consider reduced job workload, if necessary and possible, by reducing number of hours worked per week.	4. Reorganization of activities can reduce energy losses and stressors.	
5. Encourage protein, fat, and calorie intake at least equal to that recommended for the general public.	5. Protein and calorie depletion decreases activity tolerance; preventing malnutrition, achieving and maintaining recommended weight and body mass assist in management of fatigue	

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6. Encourage the use of relaxation techniques and guided imagery.	6. Promotion of relaxation and psychological rest limits contribution to physical fatigue.	
7. Encourage participation in planned exercise programs involving aerobic, resistance, and flexibility training based on individual limitations and safety measures. a. Minimum exercise for survivors depending on individual capabilities ranges from 10 minutes of light exercise, yoga, or stretching daily to 30 minutes of moderate to vigorous of activity	7. Various approaches to exercise programs have demonstrated increases in endurance and stamina and lower fatigue.	
8. Collaborate with other cancer providers to encourage them to give patients a prescription to exercise and explain role of exercise in cancer treatment.	8. Many providers fail to discuss the role of exercise and healthy lifestyle practices for patients during and after cancer treatment. Patients maybe more likely to utilize the benefits of exercise in addressing fatigue if they receive a formal prescription.	
9. Partner with community organizations (i.e., YMCA) to develop and offer cancer survivor specific rehab/exercise programs.	9. Creates community partnerships, a non-clinical environment of support, fosters increased awareness of survivorship needs, and provides referral sources that can reach more survivors.	
10. Collaborate with physical and occupational therapy; in addition, ensure safe and appropriate activities.	10. A CET designs and administers fitness assessments and exercise programs specific to an individual's cancer diagnosis, treatment, current recovery status; possesses basic understanding of cancer diagnoses, treatments, and potential adverse effects.	

Nursing Diagnosis: Chronic pain
Goal: Relief of pain and discomfort

Nursing Intervention	Rationale	Expected Outcomes
1. Use pain scale to assess pain and discomfort characteristics: location, quality, frequency, duration, etc., at baseline and on an ongoing basis.	1. Provides baseline for assessing changes in pain level and evaluation of interventions	• Reports decreased level of pain and discomfort on pain scale • Reports less disruption in activity and quality of life from pain and discomfort • Reports decrease in other symptoms and psychosocial distress • Adheres to analgesic regimen as prescribed • Barriers to adequately addressing pain do not interfere with strategies for managing pain. • Takes an active role in administration of analgesia • Identifies additional effective pain-relief strategies • Uses previously employed successful pain-relief strategies appropriately • Identifies and/or utilizes nonpharmacologic pain-relief strategies and reports successful decrease in pain • Reports that decreased level of pain permits participation in other activities and events and quality of life
2. Assure patient that you know the pain is real and will assist him or her in reducing it.	2. Fear that pain will not be considered real increases anxiety and reduces pain tolerance.	
3. Assess prior pain experiences and previous management strategies the patient found successful.	3. Helps to individualize pain management approaches and identify potential challenges or approaches that should not be utilized because of safety or other issues	
4. Assess other factors contributing to patient's pain: fear, fatigue, other symptoms, psychosocial distress, etc.	4. Provides data about factors that decrease the patient's ability to tolerate pain and increase pain level	
5. Provide education to patient and family about prescribed analgesic regimen.	5. Analgesics tend to be more effective when given early in pain cycle, around the clock at regular intervals, or when given in long-acting forms; breaks the pain cycle; premedication with analgesics is used for activities that cause increased pain or breakthrough pain.	

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6. Address myths or misconceptions and lack of knowledge about the use of opioid analgesics.	6. Barriers to adequate pain management involve patients' fear of side effects, fatalism about the possibility of achieving pain control, fear of distracting providers from treating the cancer, belief that pain is indicative of progressive disease, and fears about addiction. Professional health providers also have demonstrated limited knowledge about evidence-based approaches to pain.	
7. Collaborate with patient, primary provider, and other health care team members when changes in pain management are necessary.	7. New methods of administering analgesia must be acceptable to patient, primary provider, and health care team to be effective; patient's participation decreases the sense of powerlessness.	
8. Consult with palliative care providers or team throughout the cancer continuum.	8. Palliative care specialists provide expertise and contribute to symptom management regardless of stage of disease or treatment within the cancer continuum, not only during end-stage disease. Palliative care can improve quality of life, length of survival, symptom burden, mood, and efficient utilization of health services.	
9. Explore nonpharmacologic and complementary strategies to relieve pain and discomfort: distraction, imagery, relaxation, cutaneous stimulation, acupuncture, etc.	9. Increases the number of options and strategies available to patient that serve as adjuncts to pharmacologic interventions.	

Nursing Diagnosis: Grieving related to loss; altered role functioning
Goal: Appropriate progression through grieving process

Nursing Intervention	Rationale	Expected Outcomes
1. Encourage verbalization of fears, concerns, and questions regarding disease, treatment, and future implications.	1. An increased and accurate knowledge base decreases anxiety and dispels misconceptions.	The patient and family: • Progress through the phases of grief as evidenced by increased verbalization and expression of grief. • Identify resources available to aid coping strategies during grieving. • Use resources and supports appropriately. • Discuss the future openly with each other. • Discuss concerns and feelings openly with each other. • Use nonverbal expressions of concern for each other. • Develop positive or adaptive coping mechanisms for processing of grief.
2. Explore previous successful coping strategies.	2. Provides frame of reference and examples of coping.	
3. Encourage active participation of patient or family in care and treatment decisions.	3. Active participation maintains patient independence and control.	
4. Visit family and friends to establish and maintain relationships and physical closeness.	4. Frequent contacts promote trust and security and reduce feelings of fear and isolation.	
5. Encourage ventilation of negative feelings, including projected anger and hostility, within acceptable limits.	5. This allows for emotional expression without loss of self-esteem.	
6. Allow for periods of crying and expression of sadness.	6. These feelings are necessary for separation and detachment to occur.	
7. Involve spiritual advisor as desired by the patient and family.	7. This facilitates the grief process and spiritual care.	
8. Refer patient and family to professional counseling as indicated to alleviate pathologic or nonadaptive grieving.	8. Goal is to facilitate the grief process or adaptive methods of coping.	
9. Allow for progression through the grieving process at the individual pace of the patient and family.	9. Grief work is variable. Not every person uses every phase of the grief process, and the time spent in dealing with each phase varies with every person. To complete grief work, this variability must be allowed.	

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Nursing Diagnosis: Disturbed body image and situational low self-esteem related to changes in appearance, function, and roles
Goal: Improved body image and self-esteem

Nursing Intervention	Rationale	Expected Outcomes
1. Assess patient's feelings about body image and level of self-esteem.	1. Provides baseline assessment for evaluating changes and assessing effectiveness of interventions	• Identifies concerns of importance • Takes active role in activities • Maintains participation in decision making • Verbalizes feelings and reactions to losses or threatened losses • Participates in self-care activities • Permits others to assist in care when he or she is unable to be independent • Exhibits interest in appearance, maintains grooming, and uses aids (cosmetics, scarves, etc.) appropriately if desired • Participates with others in conversations and social events and activities • Verbalizes concern about sexual partner and/or significant others • Explores alternative ways of expressing concern and affection • The patient and significant other are able to maintain level of intimacy and express affection and acceptance.
2. Identify potential threats to patient's self-esteem (e.g., altered appearance, decreased sexual function, hair loss, decreased energy, role changes). Validate concerns with patient.	2. Anticipates changes and permits patient to identify importance of these areas to him or her	
3. Encourage continued participation in activities and decision making.	3. Encourages and permits continued control of events and self	
4. Encourage patient to verbalize concerns.	4. Identifying concerns is an important step in coping with them.	
5. Individualize care for the patient.	5. Prevents or reduces depersonalization and emphasizes patient's self-worth	
6. Assist patient in self-care when fatigue, lethargy, nausea, vomiting, and other symptoms prevent independence.	6. Physical well-being improves self-esteem.	
7. Assist patient in selecting and using cosmetics, scarves, hair pieces, hats, and clothing that increase their sense of attractiveness.	7. Promotes positive body image.	
8. Encourage patient and partner to share concerns about altered sexuality and sexual function and to explore alternatives to their usual sexual expression.	8. Provides opportunity for expressing concern, intimacy, affection, and acceptance.	
9. Refer to collaborating specialists as needed.	9. Interdisciplinary collaboration is essential in meeting patient needs.	

Collaborative Problem: Potential complication: risk for bleeding problems
Goal: Prevention of bleeding

Nursing Intervention	Rationale	Expected Outcomes
1. Monitor for factors increasing risk of bleeding (thrombocytopenia, elevated INR/PT/PTT, decreased fibrinogen or other clotting factors, use of medications affecting platelets or other clotting indices)	1. The underlying cancer, antineoplastic agents or other medications may interfere with normal mechanisms of clotting.	• Signs and symptoms of bleeding are identified. • Exhibits no blood in feces, urine, or emesis • Exhibits no bleeding of gums or injection/venipuncture sites • Exhibits no ecchymosis (bruising) or petechiae • Patient and family identify ways to prevent bleeding. • Uses recommended measures to reduce risk of bleeding (uses soft toothbrush, shaves with electric razor only) • Exhibits normal vital signs • Reports that environmental hazards have been reduced or removed • Maintains hydration • Reports absence of constipation • Avoids substances interfering with clotting • Absence of tissue destruction
2. Assess for and instruct patient/family about signs and symptoms of bleeding:	2. Early detection promotes early intervention.	
a. Petechiae or ecchymosis (bruising)	a. Petechiae and ecchymosis indicate injury to microcirculation and larger vessels.	
b. Decrease in hemoglobin or hematocrit	b. Decreased hemoglobin or hematocrit may indicate blood loss.	
c. Prolonged bleeding from invasive procedures, venipunctures, minor cuts or scratches	c. Prolonged bleeding may indicate abnormal clotting indices.	
d. Frank or occult blood in any body fluids	d. Occult blood in body fluids indicates bleeding.	
e. Bleeding from any body orifice	e. Indicates blood loss	
f. Altered mental status	f. Altered mental status may indicate decreased cerebral tissue oxygenation or bleeding.	
g. Hypotension; tachycardia	g. Hypotension or tachycardia may indicate blood loss.	

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3. Instruct patient and family about ways to minimize risk of bleeding. a. Use soft toothbrush or toothette for mouth care. b. Avoid commercial mouthwashes. c. Use electric razor for shaving. d. Use emery board for nail care. e. Avoid foods that are difficult to chew. f. Keep lips moisturized with water-based lubricant g. Maintain fluid intake of at least 3 L per 24 hours unless contraindicated h. Use stool softeners or increase bulk in diet. i. Recommend use of water-based lubricant before sexual intercourse.	3. Patient can participate in self-protection. a. Prevents trauma to oral tissues b. Contain high alcohol content that will dry oral tissues c. Prevents trauma to skin d. Reduces risk of trauma to nail beds e. Prevents oral tissue trauma f. Prevents skin from drying g. Prevents skin and oral tissue membranes from drying h. Prevents trauma to rectal mucosa from straining i. Prevents friction and tissue trauma	• Exhibits normal mental status and absence of signs of intracranial bleeding • Avoids medications that interfere with clotting (e.g., aspirin) • Absence of epistaxis and cerebral bleeding
4. Initiate measures to minimize bleeding. Draw all blood for lab work with one daily venipuncture for hospitalized patients. a. Avoid taking temperature rectally or administering suppositories and enemas. b. Avoid intramuscular injections; use smallest needle possible. c. Apply direct pressure to injection and venipuncture sites for at least 5 minutes. d. Avoid bladder catheterizations; use smallest catheter if catheterization is necessary. e. Avoid medications that will interfere with clotting (e.g., aspirin). f. Recommend use of water-based lubricant before sexual intercourse. g. Platelet transfusions as prescribed; administer prescribed diphenhydramine hydrochloride (Benadryl) or hydrocortisone sodium succinate (Solu-Cortef) to prevent reaction to platelet transfusion. h. Supervise activity when out of bed. i. Caution against forceful nose blowing.	4. Measures are taken to minimize bleeding. a. Minimizes blood loss b. Bleeding may occur from intramuscular injection sites, particularly if large bore needles are used. c. Bleeding may occur if direct pressure is not applied for a long enough time period. d. Prevents trauma to urethra e. Minimizes risk of bleeding f. Helps prevent bleeding from small skin tears. g. Platelet count <20,000/mm_3 (0.02 × 1,012/L) is associated with increased risk of spontaneous bleeding. Allergic reactions to blood products are associated with antigen–antibody reaction that causes platelet destruction. h. Reduces risk of falls i. Prevents trauma to nasal mucosa and increased intracranial pressure	

Adapted from Eaton, L. H., Mitchell, D. H., & Doorenbos, A. Z. (2015). Evidence-based practice beliefs and behaviors of nurses providing cancer pain management: A mixed-methods approach. Oncology Nursing Forum, 42(2), 165–173; Eilers, J., Harris, D., Henry, K., et al. (2014). Evidence-based interventions for cancer treatment–related mucositis: Putting evidence into practice. Clinical Journal of Oncology Nursing, 18(6), 80–96; Fogh, S., & Yom, S. S. (2014). Symptom management during the radiation oncology treatment course: A practical guide for the oncology clinician. Seminars in Oncology, 41(6), 764–775; Heston, A. H., Schwartz, A. L., Justice-Gardiner, H., et al. (2015). Addressing physical activity needs of survivors by developing a community-based exercise program: LIVESTRONG® at the YMCA. Clinical Journal of Oncology Nursing, 19(2), 213–217; Mazanec, P., & Prince-Paul, M. (2014). Integrating palliative care into active cancer treatment. Seminars in Oncology Nursing, 30(4), 203–211.

(see Chart 58-7, Risk for impaired skin integrity: erythematous and wet desquamation reactions to radiation therapy).

Alopecia

The temporary or permanent thinning or complete loss of hair is a potential adverse effect of whole brain radiation therapy, various chemotherapies and targeted agents. Alopecia usually begins 2 to 3 weeks after the initiation of chemotherapy and radiation therapy; regrowth most often begins within 8 weeks after the last treatment. Some patients who undergo radiation to the head may sustain permanent hair loss. The onset of gradually progressing alopecia and body hair loss associated with targeted therapies generally occurs 1 to 3 months after the start of treatment and may be patchy appearing as temporal or frontal

hair loss. This type of hair loss is usually reversible after the end of therapy and in some cases beginning sooner. Several targeted agents are associated with changes in hair growth rate, curliness, texture, and pigmentation. Although health care providers may view hair loss as a minor issue, for many patients it is a major assault on body image, challenging to self-esteem, and resulting in psychosocial distress and depression. Despite the significant psychosocial impact of alopecia, few studies have addressed methods to prevent or minimize the impact of alopecia. The use of cryotherapy to the head during the administration of chemotherapy has been explored but is not consistently used because of concern about later development of scalp metastasis. When cryotherapy is offered, its use avoided in patients with hematologic malignancies. Nurses provide information about hair loss and support the patient and family in coping with changes in body image. Patients are assisted to identify proactive choices that may empower them to improve responses to cancer and perceived lack of control as discussed in the nursing care plan (see Chart 58-7, Impaired tissue integrity: alopecia).

Malignant Skin Lesions

Skin lesions may occur with local extension or metastasis of the tumor into the epithelium and its surrounding lymph and blood vessels. Either locally invasive or metastatic cancer to the skin may result in redness (erythema), discolored nodules, or progression to wounds involving edema, exudates, and tissue necrosis. The most extensive lesions involve ulceration (referred to as fungating lesions) with an overgrowth of malodorous microorganisms. These lesions are a source of considerable pain, discomfort, and embarrassment. Although skin lesions occur in various malignancies, they are most commonly associated with breast cancer.

Ulcerating skin lesions usually indicate advanced or disseminated disease that is unlikely to be eradicated but may be controlled or palliated through systemic treatment (chemotherapy and targeted therapy) or radiation therapy. Local care of these lesions is a nursing priority. Nurses carefully assess malignant skin lesions for the size, appearance, condition of surrounding tissue, odor, bleeding, drainage, and associated pain or other symptoms, including evidence of infection. The potential for serious complications such as hemorrhage, vessel compression/obstruction, or airway obstruction, especially in head and neck cancer, should be noted so that the caregiver can be instructed in palliative measures to maintain patient comfort.

Nursing care (see Chart 58-7) also includes wound cleansing, reduction of superficial bacteria, control of bleeding, odor reduction, protection from further skin trauma, and pain management. The patient and family require emotional support, assistance, and guidance in providing wound care and addressing comfort measures at home.

Promoting Nutrition

Nutritional Impairment

Most patients with cancer experience some weight loss during their illness. Anorexia, malabsorption, and cancer-related anorexia-cachexia syndrome (CACS) are some common nutritional problems. Impaired nutritional status may contribute to both physical and psychosocial consequences (see Chart 58-8). Nutritional concerns include decreased protein and caloric intake, metabolic or mechanical effects of the cancer, systemic disease, side effects of the treatment, or the patient's emotional status.

Chart 58-8

Potential Consequences of Impaired Nutrition in Patients with Cancer

- Anemia
- Decreased survival
- Immune incompetence and increased incidence of infection
- Delayed tissue and wound healing
- Fatigue
- Diminished functional ability
- Decreased capacity to continue antineoplastic therapy
- Increased hospital admissions
- Increased length of hospital stay
- Impaired psychosocial functioning

Anorexia

Among the many causes of anorexia in patients with cancer are alterations in taste, manifested by increased salty, sour, and metallic taste sensations, and altered responses to sweet and bitter flavors. Taste changes contribute to decreased appetite and nutritional intake and subsequently protein–calorie malnutrition. Taste alterations may result from mineral (e.g., zinc) deficiencies, increases in circulating amino acids and cellular metabolites, or the administration of chemotherapeutic agents. Patients undergoing radiation therapy to the head and neck may experience "mouth blindness," which is a severe impairment of taste.

Anorexia may occur because patients develop early satiety after eating only a small amount of food. This sense of fullness occurs secondary to a decrease in digestive enzymes, abnormalities in the metabolism of glucose and triglycerides, and prolonged stimulation of gastric volume receptors, which convey the feeling of being full. Psychological distress (e.g., fear, pain, depression, and isolation) throughout illness may also have a negative impact on appetite. Patients may develop an aversion to food because of nausea and vomiting associated with treatment.

Malabsorption

Some patients with cancer are unable to absorb nutrients from the gastrointestinal system as a result of tumor activity, cancer treatments, or both. Malignancy can affect gastrointestinal activity in several ways (i.e., impaired enzyme production, interference with both protein and fat digestion) that can lead to increased gastrointestinal irritation, peptic ulcer disease, and fistula formation.

Chemotherapy and radiation associated with mucositis cause damage to mucosal cells of the bowel, resulting in impaired nutrient absorption. Abdominal irradiation has been associated with sclerosis of intestinal blood vessels and fibrotic changes in the gastrointestinal tissue, both impacting nutrient absorption. Surgical intervention may change peristaltic patterns, alter gastrointestinal secretions, and reduce the absorptive surfaces of gastrointestinal mucosa, all of which contribute to malabsorption.

Cancer-Related Anorexia-Cachexia Syndrome

CACS is a complex biologic process that results from a combination of increased energy expenditure and decreased intake (Alt-Epping & Nauck, 2015); (Bozzetti, 2013). This syndrome can occur in both the curative and palliative stages of treatment and care. Combined immunologic, neuroendocrine, and metabolic processes give rise to anorexia, unintentional weight loss, and increased metabolic demand with impaired

metabolism of glucose and lipids. As this syndrome continues, altered metabolic processes and tumor responses lead to cytokine release, causing generalized systemic inflammation. The patient experiences continued weight loss and malnutrition characterized by loss of adipose tissue, visceral protein, and skeletal muscle mass. Patients with CACS complain of loss of appetite, early satiety, and fatigue. As many as 80% of all patients with cancer experience some degree of cachexia (Alt-Epping & Nauck, 2015); (Bozzetti, 2013). Protein losses are associated with the development of anemia, peripheral edema, and progressive debilitation. The signs and symptoms of cancer cachexia and progressive debilitation appear to result in decreased quality of life, psychological distress, and anxiety for both patient and family as they respond to actual and perceived impending losses, fear, lack of control, and helplessness.

Nursing care is integral to an interdisciplinary approach that addresses the multiple factors contributing to impaired nutritional status in patients with cancer (see Chart 58-7).

General Nutrition Considerations

Assessment of the patient's nutritional status is conducted at diagnosis and monitored throughout the course of treatment and follow-up. Early identification of patients at risk for problems with intake, absorption, and cachexia, particularly during the early stages of disease, can facilitate timely implementation of specifically targeted interventions that attempt to improve quality of life, treatment outcomes, and survival (Bozzetti, 2013). Current weight, weight loss, diet and medication history, patterns of anorexia, nausea and vomiting, diarrhea, and situations and foods that aggravate or relieve symptoms are assessed and addressed.

The type of cancer, stage, and treatment approaches are considered so that proactive measures to support nutrition can be identified. For example, patients with head and neck cancers who are treated with radiation therapy, or some combination of surgery, radiation, chemotherapy and/or targeted agents, are at high risk for inadequate oral intake and nutritional deficits. In many centers, these patients have a percutaneous endoscopic gastrostomy (PEG) tube placed for enteral nutrition prior to initiation of treatment and the onset of mucositis, weight loss, and other consequences of impaired oral intake (Bozzetti, 2013). A speech therapy consult may be helpful for patients with oropharyngeal or laryngeal tumors or surgical interventions that are anticipated to effect swallowing, secretion management, speech, or respiratory function.

Whenever possible, every effort is made to maintain adequate nutrition through the oral route. Prokinetic agents such as metoclopramide (Reglan) are used to increase gastric emptying in patients with early satiety and delayed gastric emptying. Other pharmacologic interventions such as megestrol acetate (Megace) or corticosteroids (on a short term basis) may be used to improve appetite. Oral nutritional supplements are encouraged to meet nutritional needs and to maintain or improve weight gain and physical functioning. Supplements containing n-3 polyunsaturated fatty acids (omega-3), arginine, and nucleotides are suggested to decrease the inflammatory response and improve oxygen metabolism and intestinal function (Bozzetti, 2013). Approaches incorporate nutritional counseling, exercise, pharmacological interventions to combat anorexia, and symptom management when feasible (Alesi & del Fabbro, 2014). If adequate nutrition cannot be maintained by oral intake, nutritional support via the enteral route may be necessary as discussed previously. When needed, the patient and family are taught to administer enteral nutrition in the home.

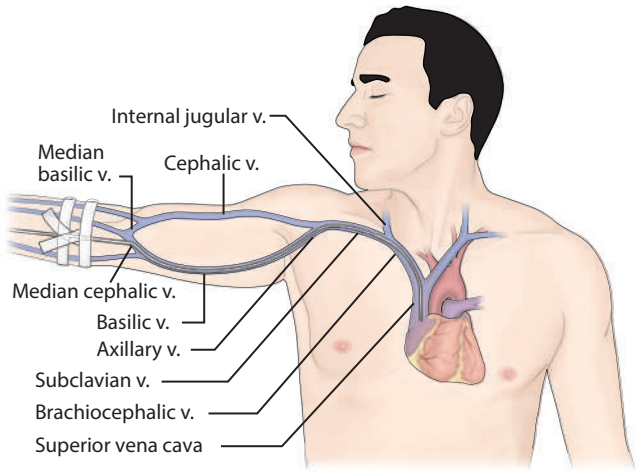


Figure 58-8 • A peripherally inserted central catheter is advanced through the cephalic or basilic vein to the axillary, subclavian, or brachiocephalic vein or the superior vena cava.

Home care nurses assist with patient education and monitor the patient's symptoms and response to enteral nutrition.

When malabsorption is a problem, enzyme and vitamin replacement may be instituted. Additional strategies include changing the feeding schedule, using simple diets, and relieving diarrhea. If malabsorption is severe, or the cancer involves the upper gastrointestinal tract, parenteral nutrition may be necessary. However, patients receiving parenteral nutrition are at increased risk for complications, including catheter-related and systemic infection. The use of parenteral nutrition in patients with advanced or end-stage cancer is seldom used and controversial (Bozzett, 2013). Parenteral nutrition can be given in several ways: by a long-term venous access device such as a right atrial catheter (see Fig. 58-5), implanted venous port (see Fig. 58-6), or PICC (see Fig. 58-8). The nurse educates the patient and family to care for the venous access device and to administer parenteral nutrition. Home care nurses provide education and assist with or supervise parenteral nutrition administration in the home.

Relieving Pain

More than half of patients with cancer experience pain throughout the cancer trajectory. Moderate to severe pain is reported by approximately 30% to 70% of patients with cancer during treatment and as many as 80% of those with advanced disease (Eaton, Mitchell, & Doorenbos, 2015). Although cancer pain may be acute, it is more frequently characterized as chronic. (See Chapter 9 for more information on pain.) As in other situations involving pain, the experience of cancer pain is influenced by physical, psychosocial, cultural, and spiritual factors.

Cancer can cause pain in various ways (see Table 58-10). Initially, pain is most often related to the underlying cancer process. Pain is also associated with various cancer treatments. Acute pain is linked with trauma from surgery. Occasionally, chronic pain syndromes, such as postsurgical neuropathies (pain related to nerve tissue injury), occur. Some chemotherapeutic agents cause tissue necrosis, peripheral neuropathies, and stomatitis—all potential sources of pain—whereas radiation therapy can cause pain secondary to skin, nervous tissue, or organ inflammation. Patients with cancer may have other sources of pain, such as arthritis or migraine headaches, that are unrelated to the underlying cancer or its treatment.

TABLE 58-10 Examples of Sources of Cancer Pain

Source	Descriptions	Underlying Cancer
Bone metastasis	Throbbing, aching	Breast, prostate, myeloma
Ischemia	Sharp, throbbing	Kaposi's sarcoma
Lymphatic or venous obstruction	Dull, aching, tightness	Lymphoma, breast, Kaposi's sarcoma
Nerve compression, infiltration	Burning, sharp, tingling	Breast, prostate, lymphoma
Organ obstruction	Dull, crampy, gnawing	Colon, gastric
Organ infiltration	Distention, crampy	Liver, pancreatic
Skin inflammation, ulceration, infection, necrosis	Burning, sharp	Breast, head and neck, Kaposi's sarcoma

The nurse assesses the patient for the source and site of pain as well as those factors that influence the patient's perception and experience of pain, such as fear and apprehension, fatigue, anger, and social isolation. Pain assessment scales (see Chapter 9) are useful for assessing the patient's pain before and after pain-relieving interventions are instituted to assess the effectiveness of interventions. Other symptoms that contribute to the pain experience, such as nausea and fatigue, are assessed and addressed as well.

In today's society, most people expect pain to disappear or resolve quickly. Although it is often controllable, advanced cancer pain is commonly irreversible and not quickly resolved. For many patients, pain is often seen as a signal that cancer is advancing and that death is approaching. As patients anticipate pain and anxiety increases, pain perception heightens, producing fear and further pain. Thus, chronic cancer pain can lead to a cycle progressing from pain to anxiety to fear and back to pain, especially when the pain is not adequately managed. Inadequate pain management is most often the result of misconceptions and insufficient knowledge about pain assessment and management on the part of patients, families, and health care providers (Eaton et al., 2015). Chapter 9 provides information regarding factors contributing to the pain experience, pain perception, and tolerance as well as pharmacologic and nonpharmacologic nursing interventions addressing pain. The nursing care plan (see Chart 58-7) also provides strategies for nursing assessment and management of chronic pain.

The World Health Organization advocates a three-step approach to treat cancer pain (see Fig. 58-9). Analgesics are given based on the patient's reported level of pain. A cancer pain algorithm, developed as a set of analgesic guiding principles, is given in Figure 58-10.

Pharmacologic and nonpharmacologic approaches, even those that may be invasive, are considered in managing cancer-related pain regardless of the patient's status along the cancer trajectory. The nurse assists the patient and family to take an active role in managing pain. The nurse provides education and support to correct fears and misconceptions about opioid use. Inadequate pain management leads to a diminished quality of life characterized by distress, suffering, anxiety, fear, immobility, isolation, and depression.

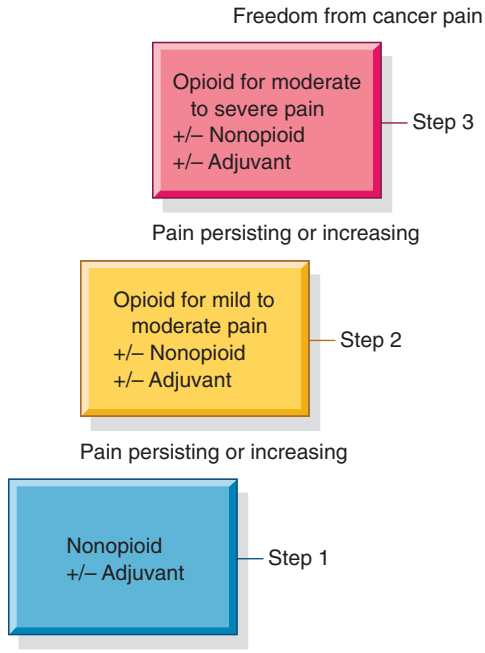


Figure 58-9 • Adapted from the World Health Organization three-step ladder approach to relieving cancer pain. Various opioid (narcotic) and nonopioid medications may be combined with other medications to control pain.

Decreasing Fatigue

Fatigue is one of the most frequent and distressing symptoms experienced by patients receiving cancer therapy. Patients report that fatigue persists and interferes with activities of daily living for months to years after the completion of treatment (Pachman, Price, & Carey, 2014). Fatigue rarely exists in isolation; patients typically experience other symptoms concurrently, such as pain, dyspnea, anemia, sleep disturbances, or depression.

In assessing fatigue, the nurse distinguishes between *acute fatigue,* which occurs after an energy-demanding experience, and *cancer-related fatigue,* which is defined as "a distressing persistent, subjective sense of physical, emotional and/or cognitive tiredness or exhaustion related to cancer or cancer treatment that is not proportional to recent activity and interferes with usual functioning" (NCCN, 2015f). Acute fatigue serves a protective function, whereas cancer-related fatigue does not. The exact mechanisms of fatigue are not well understood and are multifactorial in nature.

Despite the commonly occurring experience of fatigue in patients with cancer, a reliable assessment tool has not been identified. The experience of fatigue is highly subjective, with patient descriptors varying greatly (NCCN, 2015f). The nurse assesses physiologic and psychological factors that can contribute to fatigue (see Chart 58-9).

Exercise and physical activity are effective approaches to the management of cancer-related fatigue (Pachman et al., 2014). Psychoeducational approaches, cognitive-behavioral therapy to address sleep, progressive muscle relaxation, yoga and mindfulness meditation maybe effective measures to facilitate fatigue management (Mitchell, Hoffman, Clark, et al., 2014). Nurses assist patients with strategies to minimize fatigue or help the patient cope with fatigue as described in the nursing care plan (see Chart 58-7). Occasionally, pharmacologic interventions are utilized, including antidepressants for patients

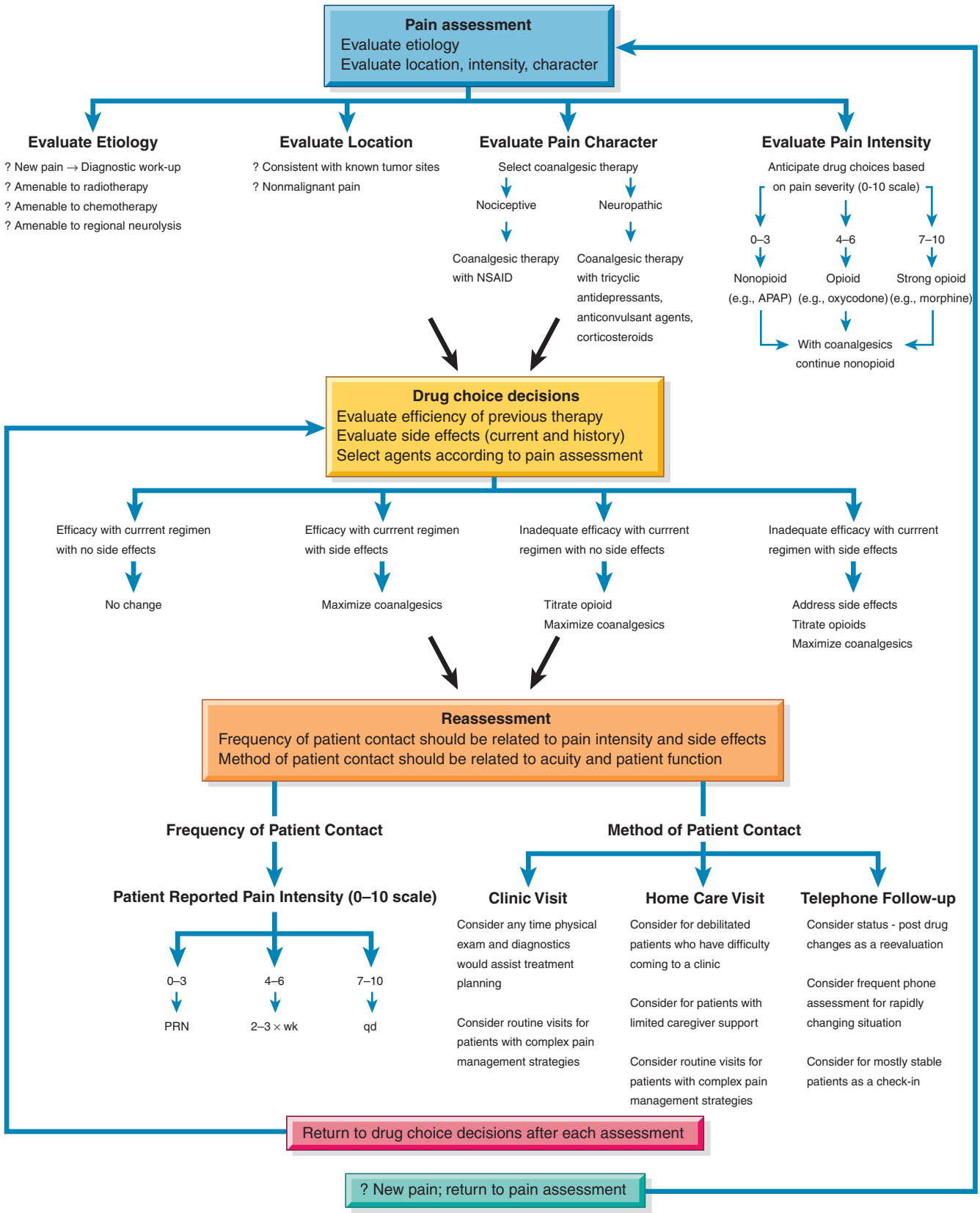


Figure 58-10 • The cancer pain algorithm (highest-level view) is a decision-tree model for pain treatment. Redrawn with permission from DuPen, A. R., DuPen, S., Hansberry, J., et al. (2000). An educational implementation of a cancer pain algorithm for ambulatory care. Pain Management Nursing, 1(4), 118.

Chart 58-9

Sources of Fatigue in Patients with Cancer

- Pain, pruritus
- Imbalanced nutrition related to nausea, vomiting, cancer-related anorexia-cachexia syndrome
- Electrolyte imbalance related to vomiting, diarrhea
- Ineffective protection related to neutropenia, thrombocytopenia, anemia
- Impaired tissue integrity related to stomatitis, mucositis
- Impaired physical mobility related to neurologic impairments, surgery, bone metastasis, pain, and analgesic use
- Uncertainty and deficient knowledge related to disease process, treatment
- Anxiety related to fear, diagnosis, role changes, uncertainty of future
- Ineffective breathing patterns related to cough, shortness of breath, and dyspnea
- Disturbed sleep pattern related to cancer therapies, anxiety, and pain

Adapted from Bryant, A. L., Walton, A. L., & Phillips, B. (2015). Cancer-related fatigue: Scientific progress has been made in 40 years. Clinical Journal of Oncology Nursing, 19(2), 137–139; National Comprehensive Cancer Network. (2015f). NCCN guidelines for supportive care: Cancer related fatigue. Retrieved on 3/24/2016 at: www.nccn.org/professionals/physician_gls/f_guidelines.asp#fatigue

with depression, anxiolytics for those with anxiety, hypnotics for patients with sleep disturbances, and psychostimulants for some patients with advanced cancer or fatigue that does not respond to other interventions (NCCN, 2015f).

Improving Body Image and Self-Esteem

The nurse identifies potential threats to the patient's body image and assesses the patient's ability to cope with the many bodily changes that may be experienced throughout the course of disease and treatment. Entry into the health care system is often accompanied by depersonalization. Threats to self-concept occur as the patient faces the realization of illness, disfigurement, possible disability, and death. To accommodate treatments or because of the disease, many patients with cancer are forced to alter their lifestyles. Priorities and values change when body image is threatened. Disfiguring surgery, hair loss, cachexia, skin changes, altered communication patterns, and sexual dysfunction can threaten the patient's self-esteem and body image.

A creative and positive approach is essential when caring for patients with altered body image. Nursing strategies for addressing issues related to body image and self-esteem are included in the nursing care plan (see Chart 58-7). The nurse serves as a listener and counselor to both the patient and the family. Possible influences of the patient's culture and age are considered when discussing concerns and potential interventions.

Addressing Sexuality

The physiologic processes associated with cancer; potential short- and long-term effects of cancer treatments; and psychosocial, emotional, and spiritual responses to the entire experience may lead patients to confront a variety of sexuality-based issues. Patients at the greatest risk of sexual dysfunction are those with tumors that involve the sexual or pelvic organs and those whose treatment affects the hormonal systems mediating sexual function (Goldfarb, Mulhall, Nelson, et al., 2013). Although sexuality is an important component of overall health, many nurses and other health professionals are hesitant to include sexuality in their discussions with patients (Kelvin, Steed, & Jarrett, 2014). Workshops have been developed to help nurses overcome barriers to discussing sexuality (Smith, 2015). In offering a holistic approach to the care of patients with cancer, nurses should initiate discussions about sexuality and assess sexual health.

Infertility, a common consequence of cancer and cancer treatments, can be of concern to patients and their partners. The potential for impaired fertility is discussed and options reviewed for fertility preservation (Frankel Kelvin, 2015). Fertility plans are discussed and determined prior to the initiation of any therapy that may compromise reproductive abilities.

Referrals are made as needed for specialized evaluation and interventions that are beyond the scope of nursing intervention.

Assisting in the Grieving Process

A cancer diagnosis need not indicate a fatal outcome. Many forms of cancer are curable, and others may be controlled for long periods of time similar to the course of other chronic diseases. Despite the tremendous advances in cancer, many patients and their families still view cancer as a fatal disease that is inevitably accompanied by pain, suffering, debilitation, and emaciation. Grieving is a normal response to these fears and to actual or potential losses: loss of health, normal sensations, body image, social interaction, intimacy, independence, and usual social roles. Patients, families, and friends may grieve for the loss of quality time to spend with others, the loss of future and unfulfilled plans, and the loss of control over the patient's body and emotional reactions. Nurses continue to assess the patient and family for positive or maladaptive coping behaviors, interpersonal communication, and evidence of the need for additional psychosocial support or interventions such as referral for professional counseling.

If the patient enters the terminal phase of disease, the nurse may assess that the patient and family members are at different stages of grief. In such cases, the nurse assists the patient and family to acknowledge and cope with their reactions and feelings. The nurse also empowers the patient and family to explore preferences for issues related to end-of-life care, such as withdrawal of active disease treatment, desire for the use of life-support measures, and symptom management approaches. Oncology nurses respectfully support the patient's spiritual or religious views. In addition, nurses consider the patient's cultural beliefs and practices when addressing issues related to grief. After the death of a patient with cancer, home care and/or hospice nurses follow up with surviving family members for bereavement counseling to facilitate expression and coping with feelings of loss and grief. (See Chapter 59 for further discussion of end-of-life issues.)

Management of Psychosocial Distress

Despite advances in cancer care, patients experience varying levels of psychosocial distress related to actual or potential losses, fear of the unknown, symptoms due to cancer or cancer treatments, changes in usual family and social roles, financial concerns, and a sense of loss of control. Psychosocial distress is defined as a multifactorial unpleasant emotional experience of a psychological (cognitive, behavioral, emotional), social, and/or spiritual nature

that may interfere with the ability to cope effectively with cancer, its physical symptoms and its treatment (NCCN, 2015g). Distress occurs along a continuum, ranging from common normal feelings of vulnerability, sadness, and fears to problems that can become disabling, such as depression, anxiety, panic, social isolation, and existential and spiritual crisis. Distress that is not addressed can have a significant impact on the overall well-being, interpersonal relationships, cognitive abilities, and adherence to treatment regimens, leading to poor outcomes.

Nurses need to screen patients for psychosocial distress during the course of the cancer experience. Patients are supported in managing various sources and levels of distress. Referral to mental health providers may be helpful to address specific concerns (Schilli, 2014).

Monitoring and Managing Potential Complications

Infection

For patients in all stages of cancer, the nurse assesses factors associated with the development of infection. Although infection-associated morbidity and mortality have greatly decreased, prevention and prompt treatment of infection are essential in patients with cancer. Often, more than one predisposing factor is present in patients with cancer. The nurse monitors laboratory studies to detect early changes in WBC counts. Common sites of infection, such as the pharynx, skin, perianal area, urinary, and respiratory tracts, are assessed on a regular basis. However, the typical signs of infection (swelling, redness, drainage, and pain) may not occur in myelosuppressed patients because of decreased circulating WBCs and a diminished local inflammatory response. Fever may be the only sign of infection (NCCN, 2015h). The nurse monitors the patient for sepsis, particularly if invasive catheters or long-term IV catheters are in place.

WBC function is often impaired in patients with cancer. Among the five types of WBCs, (neutrophils [granulocytes], lymphocytes, monocytes, basophils, and eosinophils), neutrophils serve as the body's primary initial defense against invading organisms. Comprising 60% to 70% of the body's WBCs, neutrophils act by engulfing and destroying infective organisms through phagocytosis. Both the total WBC count and the concentration of neutrophils are important in determining the patient's ability to fight infection. A decrease in circulating WBCs is referred to as leukopenia. Granulocytopenia is a decrease in neutrophils.

A differential WBC count identifies the relative numbers of WBCs and permits tabulation of polymorphonuclear neutrophils (PMNs) or segmented neutrophils (mature neutrophils, reported as "polys," PMNs, or "segs") and immature forms of neutrophils (reported as bands, metamyelocytes, and "stabs"). The absolute neutrophil count (ANC) is calculated by the following formula:

$$\text{ANC} = (\text{segmented neutrophils [\%]} + \text{bands [\%]}) \times \text{WBC count (cells/mm3)}$$

Example: $(25\% \text{ segs} + 25\% \text{ bands}) \times 6000 \text{ WBC cells/mm}^3 = 3000 \text{ ANC}$

Neutropenia, an abnormally low ANC, is associated with an increased risk of infection. The risk of infection rises as the ANC decreases. As the ANC declines below 1,500 cells/mm^3, the risk of infection rises. An ANC less than 500 cells/mm^3 reflects a severe risk of infection (NCCN, 2015h); (Segal, Walsh, Gea-Banacloche, et al., 2015). The ***nadir*** is the lowest ANC following chemotherapy, targeted therapy, or radiation therapy that suppresses bone marrow function. Severe neutropenia may necessitate delays in administration of myelosuppressive therapies or treatment dose adjustments, although the use of the hematopoietic growth factors (i.e., colony-stimulating factors; see previous discussion) has reduced the severity and duration of treatment-associated neutropenia as well as infection-related morbidity and early death (Smith, Bohlke, Lyman, et al., 2015). The administration of these growth factors assists in maintaining treatment schedules, drug dosages, treatment effectiveness, and quality of life.

Febrile patients who are neutropenic are assessed for factors that increase the risk of infection and for sources of infection through cultures of blood, sputum, urine, stool, IV and urinary or other catheters, and wounds, if appropriate (see Table 58-11). In addition, a chest x-ray is usually obtained to assess for pulmonary infection.

Defense against infection is compromised in many different ways. The integrity of the skin and mucous membranes is challenged by multiple invasive diagnostic procedures, by the adverse effects of all cancer treatment modalities, and by the detrimental effects of immobility. Impaired nutrition as a result of CACS, nausea, vomiting, diarrhea, and the underlying disease alters the body's ability to combat invading organisms. Medications such as antibiotics disturb the balance of normal flora, allowing the overgrowth of normal flora and pathogenic organisms. Other medications can also alter the immune response (see Chapter 54). Cancer itself may lead to defects in cellular and humoral immunity. Advanced cancer may cause obstruction of hollow viscera (e.g., intestines), blood, and lymphatic vessels, creating a favorable environment for proliferation of pathogenic organisms. In some patients, tumor cells infiltrate bone marrow and prevent normal production of WBCs.

Nurses are in a key position to assist in preventing and identifying symptoms of infection, as discussed in the nursing care plan (see Chart 58-7). Clinical practice guidelines developed by the ONS, the Infusion Nurses Society (INS), the NCCN, and the ASCO are used to guide prevention and management of infection. Interventions to prevent infection and alternative patient education formats for infection-related instruction are high nursing research priorities.

Gram-positive bacteria (*Streptococcus,* enterococci, and *Staphylococcus* species) and gram-negative organisms (*Escherichia coli, Klebsiella pneumoniae, Enterobacter,* and *Pseudomonas aeruginosa*) are the most frequently isolated causes of infection. Fungal organisms, such as *Candida albicans,* also contribute to the incidence of serious infection. Viral infections in immunocompromised patients are caused most often by herpes simplex, respiratory syncytial, parainfluenza, and influenza A and B viruses.

Fever is reported promptly as it is an important sign of infection in patients when associated with neutropenia. Patients with neutropenic fever (see Table 58-11) are assessed for infection and reported promptly (NCCN, 2015h). Antibiotics may be prescribed after cultures of wound drainage, exudates, sputum, urine, stool, or blood are obtained. Careful consideration is given to the underlying malignancy, prior antineoplastic treatment, ANC, comorbidities, and other patient-related factors prior to the identification of the most appropriate antibiotic therapy. Evidence-based guidelines are available for prevention and treatment of cancer-related infections (NCCN, 2015h). Patients with neutropenia are treated with broad-spectrum antibiotics before the infecting organism is identified because of the

TABLE 58-11 Assessment of Neutropenic Fever in Patients with Cancer

Fever Criteria	Neutropenia Criteria
• Any one-time temperature of 38.3°C (101°F) or • Any temperature of ≥38°C (100.4°F) or ≥1 h	• <500 neutrophils/mcL or • <1000 neutrophils/mcL and predicted to decline to ≤500 neutrophils/mcL over the next 48 hours

Assessment Targets for Neutropenic Fever Evaluation			
Infection Risk Factors	**Physical Assessment**	**Diagnostic Procedures**	**Microbiologic Cultures**
• Chronic comorbid illnesses • Underlying hematologic malignancies • Immunosuppression related to factors other than neutropenia (i.e., immunosuppressive therapy following allogeneic HSCT or hypogammaglobulinemia [decreased gammaglobulin production]) • Solid tumors causing obstructions of the bronchial tree, ureters, colon, or biliary ducts • Advanced or refractory underlying malignancy • Prolonged duration of neutropenia • Age ≥65 years • Limited mobility and/or debilitation • Medications (e.g., corticosteroids such as prednisone) • Antibiotic therapy or prophylaxis • Recent surgery for diagnosis or treatment • Chemotherapy or targeted therapy received within the last 7–10 days • Prior treatment with multiple types of chemotherapy regimens • Recent radiation therapy; especially to areas associated with bone marrow reserves • Prior documented infections • Impaired skin integrity • Invasive drainage or urinary catheters • Peripheral or central venous access devices • Exposures (travel, others with infection, blood administration, pets) • Diarrhea • Poor nutritional status • Recent lumbar puncture or indwelling Ommaya reservoir™ (long-term intraventricular catheter for administration of chemotherapy into CSF and ventricles)	• Skin, pressure points, wounds • Surgical or biopsy incision sites • IV access or reservoir sites • Drainage catheter sites • Tracheostomy site • Lungs and sinuses • Perivaginal and perirectal area • Alimentary canal, abdomen • Neurologic assessment • Vital signs	• Diagnostic imaging as appropriate to identify abscesses, fistulas, pneumonia, obstruction, etc. • Complete blood count/differential • Serum chemistries, liver function tests • Renal function tests • Pulse oximetry or arterial blood gases • Lumbar puncture for CSF analysis	• Blood (peripheral and central venous access if applicable) • Urine (especially with indwelling catheter) • Skin wounds, lesions, incision sites, catheter exit sites • Catheter tips when feasible • Drainage from catheters • Stool, diarrhea • Sputum • CSF

CSF, cerebrospinal fluid.

Adapted from National Comprehensive Cancer Network. (2015h). Clinical practice guidelines: Prevention and treatment of cancer related infections (v2.2015). Available at: www.nccn.org/professionals/physician_gls/pdf/infections.pdf; Segal, B. H., Walsh, T. J., Gea-Banacloche, J. C., et al. (2015). Infections in the cancer patient. In V. T., DeVita, T. S., Lawrence, & S. A., Rosenberg, (Eds.). Cancer: Principles & practice of oncology. Philadelphia: Lippincott Williams & Wilkins.

increased risk of mortality associated with untreated infection. Broad-spectrum antibiotic therapy targets the most likely major pathogenic organisms. It is important for these medications to be given and taken promptly as scheduled to achieve adequate blood levels. Once the offending organism is identified, more specific antimicrobial therapy is prescribed as appropriate. Nurses provide education for patients and families regarding prevention of infection, signs and symptoms to report, and the importance of adherence to prescribed antimicrobial therapy.

Septic Shock

The nurse assesses the patient frequently for signs and symptoms of infection and inflammation throughout the trajectory of cancer care. Sepsis and septic shock are life-threatening complications that must be prevented or detected and treated promptly. Although all patients with cancer are at risk, patients who are neutropenic or who have hematologic malignancies are at the greatest risk. Patients with signs and symptoms of impending sepsis and septic shock require immediate hospitalization and aggressive treatment in the intensive care setting. (See Chapter 8 for discussion of sepsis and septic shock.)

Bleeding and Thrombocytopenia

Platelets are essential for normal blood clotting and coagulation (hemostasis). Thrombocytopenia, a decrease in the circulating platelet count, is the most common cause of bleeding in patients with cancer and is usually defined as a platelet count less than 100,000/mm^3 (0.1×10^{12}/L). The risk of bleeding increases when the platelet count decreases below 50,000/mm^3 (0.05×10^{12}/L). At platelet counts lower than 10,000/mm^3 (0.02×10^{12}/L), the risk for spontaneous bleeding is increased (Barbarotta, 2015).

Thrombocytopenia often results from bone marrow depression after certain types of chemotherapy and radiation therapy and with tumor infiltration of the bone marrow. In some cases, platelet destruction is associated with an enlarged spleen (hypersplenism) and abnormal antibody function, which occur with leukemia and lymphoma. Bacterial and viral infections may lead to early platelet destruction or impaired bone marrow production of platelets and subsequent thrombocytopenia. Some medications (i.e., heparin, vancomycin) may cause bone marrow toxicity leading to decreases in circulating platelets. Less commonly, posttransfusion complications may lead to antibody destruction of platelets causing profound

thrombocytopenia. Lastly, coagulopathies associated with infection or malignancies, such as gastric and pancreatic cancer, may result in thrombocytopenia (Kuter, 2015). The nursing care plan addresses nursing assessment parameters and interventions for patients at risk for bleeding (see Chart 58-7).

Nursing Alert: Although laboratory test results confirm the diagnosis of thrombocytopenia, the patient who is developing thrombocytopenia may display early signs and symptoms. Thus, nurses need to observe keenly for petechiae and ecchymoses, which are early indicators of decreasing platelet levels. Early detection promotes early intervention.

Additional medications may be prescribed to address bleeding or thrombocytopenia based on the underlying etiology. (Refer to Chapter 27 for further discussion of assessment and treatment of thrombocytopenia and coagulopathies.)

Venous thromboembolism (VTE), a common problem for patients with cancer, includes deep venous thrombosis (DVT), pulmonary embolism (PE), superficial venous thrombosis (SVT), and thrombosis in other abdominal or thoracic venous tributaries such as the mesenteric veins or the superior vena cava. The incidence of VTE has been linked to an increased likelihood of death in patients with cancer (NCCN, 2015i). Factors associated with risk for VTEs in cancer patients include pre-existing underlying or cancer-related coagulopathies, medications including chemotherapy, hospitalizations, surgical procedures, increased age, debilitation, immobility, infection, and peripheral and central venous catheters (NCCN, 2015i). Patients with cancer are monitored for associated risk factors and are assessed on an ongoing basis for VTE. Nurses provide patient and family education regarding symptoms of VTE to report to the provider. Recommendations for prophylaxis are based on national guidelines and patient risk factors. Nursing assessment findings associated with VTE are reported promptly so that VTE evaluation and treatment can be initiated expeditiously.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

Most commonly, patients with cancer are diagnosed and treated in the outpatient setting. Nurses in outpatient settings often have the responsibility for patient education and helping coordinate care in the home (see Chart 58-10). The shift of care from acute care facilities to the home or outpatient settings as well as the increasing use of oral antineoplastic agents places significant responsibility for care on the patient and family. In order to maintain optimal patient outcomes and quality of life, patients and families require support and information that will prepare them to engage in self-care. Education initially focuses on the most immediate care needs likely to be encountered at home.

Approaches to preparing patients for self-care responsibilities are chosen with consideration of the patient's preferred learning strategies, level of education, and health literacy. Knobf (2013) suggests that patient education is best achieved through a nurse–patient relationship that involves an exchange of information to support patient needs that can vary across time points of the cancer continuum. Easily understood, concrete, objective information that assists patients to understand what to expect and includes sensory and temporal components is important. Symptoms, side effects of treatment, and changes in the patient's status that should be reported are discussed and reinforced with printed materials that can be referred to in the home. Nurses help to empower patients by sharing strategies to manage side effects or other symptoms. Additional learning needs are based on the priorities conveyed by the patient and family as well as on the complexity of care required.

Technologic advances allow home administration of IV chemotherapy, blood products, and antibiotics; enteral or parenteral nutrition; and parenteral analgesics. Patients and families are taught to care for vascular access devices, infusion pumps, various types of drainage catheters, and on occasion complex wounds. The importance of patient safety and infection control is included in patient and family education. Although

Chart 58-10 HOME CARE CHECKLIST

The Patient Receiving Care for an Oncologic Disorder

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of cancer treatment on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- State changes in lifestyle (e.g., diet, activity) necessary to maintain health.
- State the name, dose, side effects, frequency, and schedule for all medications.
- Demonstrate how to administer the chemotherapy agent in the home:
  - Describe safe storage and handling of oral chemotherapy/targeted agents in the home.
  - Demonstrate safe disposal of needles, syringes, IV supplies, or unused chemotherapy medications.
  - List possible side effects of chemotherapeutic agents and suggested management approaches.
- List possible side effects of radiation therapy and suggested management approaches.
- List complications of medications/therapeutic regimen necessitating a call to the nurse or primary provider.
- List complications of medications/therapeutic regimen necessitating a visit to the emergency department.
- Locate list of names and telephone numbers of resource personnel involved in care (e.g., home care nurse, infusion services, IV vendor, equipment company, radiation therapy department).
- Explain treatment plan and importance of upcoming visits to the primary provider.
- State how to obtain medical supplies after discharge.
- Identify durable medical equipment needs, proper usage, and maintenance necessary for safe utilization.
- Demonstrate usage of adaptive equipment for ADLs.
- Identify community resources for peer and caregiver/family support:
  - Identify sources of support (e.g., friends, relatives, faith community)
  - Identify phone numbers of support groups for people with cancer and their caregivers/families
  - State meeting locations and times
- Identify the need for health promotion, disease prevention, and screening activities

ADL, activities of daily living; IADL, independent activities of daily living.

TABLE 58-12 Age-Related Changes and their Effects on Patients with Cancer

Age-Related Changes	Implications
Impaired immune system	Use special precautions to avoid infection; monitor for atypical signs and symptoms of infection.
Altered drug absorption, distribution, metabolism, and elimination	Mandates careful calculation of chemotherapy and frequent assessment for drug response and side effects; dose adjustments may be necessary.
Increased prevalence of other chronic diseases	Monitor for effect of cancer or its treatment on patient's other chronic diseases; monitor patient's tolerance for cancer treatment; monitor for interactions with medications used to treat chronic diseases.
Diminished renal, respiratory, and cardiac reserve	Be proactive in prevention of decreased renal function, atelectasis, pneumonia, and cardiovascular compromise; monitor for side effects of cancer treatment.
Decreased skin and tissue integrity; reduction in body mass; delayed healing	Prevent pressure ulcers secondary to immobility; monitor skin and mucous membranes for changes related to radiation or chemotherapy; monitor nutritional status.
Decreased musculoskeletal strength	Prevent falls; assess support for performing activities of daily living in home setting; encourage safe use of assistive mobility devices.
Decreased neurosensory functioning: loss of vision, hearing, and distal extremity tactile senses	Provide instruction modified for patient's hearing and vision changes; provide instruction concerning safety and skin care for distal extremities; assess home for safety.
Altered social and economic resources	Assess for financial concerns, living conditions, and resources for support.
Potential changes in cognitive and emotional capacity	Provide education and support modified for patient's level of functioning and safety.

nurses are often available to provide some assistance with cancer care in the home, patients and families need information that will enable them to have a sense of comfort, decrease distress, improve coping, foster self-management, promote adherence, and enhance quality of life (Knobf, 2013).

Continuing and Transitional Care

Referral for home or transitional care is often indicated for patients with cancer. The responsibilities of the nurse include assessing the home environment and suggesting modifications in the home or in care to help address the patient's physical and safety needs. Home care nurses also assess the psychosocial impact of cancer on the patient and family so that appropriate interventions can be identified and/or referrals for support services are instituted.

Ongoing nursing visits and/or phone contact from the home or transitional care nurse assist in prevention, early identification, prompt reporting, and management of patient problems. Timely modifications in therapy to manage symptoms and adverse effects of treatment may decrease patient suffering and decrease emergency department visits or hospital admissions. Continued contact facilitates evaluation of the patient's progress, responses to treatment, and assessment of the ongoing needs of the patient and family. It is necessary to assess the patient's and family's understanding of the treatment plan and management strategies and to reinforce previous education. The nurse facilitates coordination of patient care by maintaining close communication with all involved health care providers. The nurse may make referrals and coordinate available community resources (e.g., home aides, community nurses, support groups) to assist patients and caregivers.

Gerontologic Considerations

Approximately 53% of cancer incidence and 69% of cancer deaths occur in persons aged 65 years or older (ACS, 2015a). The rising number of individuals over age 65 with cancer has led to the emergence of geriatric oncology, a multidimensional and multidisciplinary approach to treating growing numbers of older adults with cancer.

Nurses working with older adults must understand the normal physiologic changes that occur with aging and the implications for the patient with cancer (see Table 58-12). These changes that affect all body systems may ultimately influence older patients' responses to cancer treatment. In addition, many older patients have other chronic diseases requiring multiple medications. The existence of comorbidities and multiple medications may contribute to drug interactions and toxicities in older patients.

The understanding of the effects and tolerance of chemotherapy, targeted therapies, and radiation in the older adult is limited, as older adults have been underrepresented in oncology clinical trials. Potential chemotherapy-related toxicities, such as renal impairment, myelosuppression, fatigue, and cardiomyopathy, may increase as a result of declining organ function and diminished physiologic reserves. The recovery of normal tissues after radiation therapy may be delayed, and older adult patients may experience more severe adverse effects, such as mucositis, nausea and vomiting, and myelosuppression. Because of impaired healing and declining pulmonary and cardiovascular functioning, older patients are slower to recover from surgery. Older patients are also at increased risk for complications, such as atelectasis, pneumonia, and wound infections.

SELECTED MALIGNANT CONDITIONS

Breast Cancer

Breast cancer is a major health problem in the United States. Current statistics indicate that over a lifetime (birth to death), a woman's risk of developing breast cancer is about 12%, or one

in eight. Currently, about 231,840 new cases of invasive breast cancer are diagnosed in women each year. Risk of developing breast cancer increases with increasing age. About two of three invasive breast cancers are found in women 55 years or older. About 5% to 10% of breast cancer cases are thought to be hereditary, resulting directly from gene defects (cell mutations) inherited from a biologic parent (ACS, 2015).

Breast cancer has been ranked number one cancer among Indian women with age-adjusted rate as high as 25.8 per 100,000 women and mortality 12.7 per 100,000 women. Data reports from various latest national cancer registries were compared for incidence and mortality rates. The age-adjusted incidence rate of carcinoma of the breast was found as high as 41 per 100,000 women in Delhi, followed by Chennai (37.9), Bangalore (34.4), and Thiruvananthapuram District (33.7). A statistically significant increase in age-adjusted rate over time (1982–2014) in all the population-based cancer registries (PBCRs) namely Bangalore (annual percentage change: 2.84%), Barshi (1.87%), Bhopal (2.00%), Chennai (2.44%), Delhi (1.44%), and Mumbai (1.42%) was observed (Malvia, Bagadi, Dubey, et al., 2017).

Female breast cancer incidence rates vary substantially by race and ethnicity. Higher death rates in African Americans have been attributed to later stage at diagnosis and poorer stage-specific survival. Research suggests that racial disparities in cancer mortality are driven in large part by differences in socioeconomic status (ACS, 2013).

Types of Breast Cancer

Ductal Carcinoma in Situ

Ductal carcinoma in situ (DCIS) is characterized by the proliferation of malignant cells inside the milk ducts without invasion into the surrounding tissue. Unlike invasive breast cancer, DCIS does not metastasize and a woman generally does not die of DCIS unless it develops into invasive breast cancer. DCIS can develop into invasive breast cancer if left untreated. The best estimates are that 14% to 53% of untreated DCIS progresses to invasive breast cancer over a period of 10 years or more. However, the natural history of DCIS is not well understood, and it is currently not possible to accurately predict which women with DCIS will go on to develop invasive breast cancer (ACS, 2015). DCIS is frequently manifested on a mammogram with the appearance of calcifications and is considered breast cancer stage 0.

Medical Management

Current management takes into account (1) assurance of an accurate diagnosis, (2) assessment of DCIS size and grade, and (3) careful margin evaluation. The pathologist analyzes the piece of breast tissue removed to determine the type and grade of the DCIS or how abnormal the cells look when compared with normal breast cells and how fast they are growing. Grade III (high-grade DCIS) cells tend to grow more quickly than grade I (low-grade) and grade II (moderate-grade) cells and look much different from normal breast cells. Accurate grading of DCIS is critical, because high nuclear grade and the presence of necrosis (the premature death of cells in living tissue) are highly predictive of the inability to achieve adequate margins or borders of healthy tissue around the cancer, of local recurrence, and of the probability of missed areas of invasion. The pros and cons of irradiating patients with DCIS who are treated conservatively should be carefully weighed on a case-by-case basis, considering recent trials have shown that radiation has a beneficial effect on distant recurrence, breast cancer–specific mortality, and overall survival. Breast conservation (treatment of a breast cancer without the loss of the breast) can be curative for well-defined subsets of women with DCIS (ACS, 2015).

Invasive Cancer

The NCCN (2015), a nonprofit group of the world's 21 leading cancer centers, disseminates estimates for various types of cancer.

Infiltrating Ductal Carcinoma

Infiltrating ductal carcinoma—the most common histologic type of breast cancer—accounts for 80% of all cases. The tumors arise from the duct system and invade the surrounding tissues. They often form a solid irregular mass in the breast.

Infiltrating Lobular Carcinoma

Infiltrating lobular carcinoma accounts for 10% to 15% of breast cancers. The tumors arise from the lobular epithelium and typically occur as an area of ill-defined thickening in the breast. They are often multicentric and can be bilateral.

Medullary Carcinoma

Medullary carcinoma accounts for about 5% of breast cancers, and it tends to be diagnosed more often in women younger than 50 years. The tumors grow in a capsule inside a duct. They can become large and may be mistaken for a fibroadenoma. The prognosis is often favorable.

Mucinous Carcinoma

Mucinous carcinoma accounts for about 3% of breast cancers and often presents in women who are postmenopausal and are 75 years and older. A mucin producer, the tumor is also slow growing; thus, the prognosis is more favorable than in many other types.

Tubular Ductal Carcinoma

Tubular ductal carcinoma accounts for about 2% of breast cancers. Because axillary metastases are uncommon with this histology, prognosis is usually excellent. Micropapillary invasive ductal carcinoma is a rare type of aggressive ductal cancer characterized by a high rate of axillary node metastasis and skin involvement.

Inflammatory Carcinoma

Inflammatory carcinoma is a rare (1% to 3%) and aggressive type of breast cancer that has unique symptoms. The cancer is characterized by diffuse edema and erythema of the skin, often referred to as peau d'orange (resembling an orange peel). This is caused by malignant cells blocking the lymph channels in the skin. An associated mass may or may not be present; if there is a mass, it is often a large area of indiscrete thickening. Inflammatory carcinoma can be confused with an infection because of its presentation. The disease can spread to other parts of the body rapidly. Chemotherapy often plays an initial role in controlling disease progression, but radiation and surgery may also follow.

Paget Disease

Paget disease of the breast accounts for 1% of diagnosed cases of breast cancer (Grossman & Porth, 2014). Symptoms typically include a scaly, erythematous, pruritic lesion of the nipple. Paget disease often represents DCIS of the nipple but may have an invasive component. If no lump can be felt in the breast tissue and the biopsy shows DCIS without invasion, the prognosis is very favorable.

Risk Factors

There is no single, specific cause of breast cancer. A combination of genetic, hormonal, and possibly environmental factors may increase the risk of its development (see Table 58-13). More than 80% of all cases of breast cancer are sporadic, meaning that patients have no known family history of the disease. The remaining cases are either familial (there is a family history of breast cancer, but it is not passed on genetically) or genetically acquired. There is no evidence that smoking, silicone breast implants, the use of antiperspirants, underwire bras, or abortion (induced or spontaneous) increases the risk of the disease. There is some evidence that long-term smoking, starting before first pregnancy, and night shift work may increase the risk for breast cancer (ACS, 2015).

As stated previously, breast cancer can be genetically inherited, resulting in significant risk. Approximately 5% to 10% of breast cancer cases have been linked to specific genetic mutations. Factors that may indicate a genetic link include multiple first-degree relatives with early-onset breast cancer, breast and ovarian cancer in the same family, male breast cancer, and Ashkenazi Jewish background. *BRCA1* and *BRCA2* are tumor suppressor genes that normally function to identify damaged deoxyribonucleic acid (DNA) and thereby restrain abnormal cell growth (Yarbo, Wujcik, & Gobel, 2013). Mutations in these genes on chromosome 17 are responsible for the majority of hereditary breast cancer. *BRCA* mutations in women have been associated with an overall risk of breast cancer up to 65% (ACS, 2015). Currently, women who are *BRCA* positive are counseled to start screening, typically using mammography, once a year and then MRI 6 months after the yearly mammography by 25 years of age, or 5 to 10 years earlier than their youngest affected family member. Mutations in the PALB2 gene confer similar risk. Males who carry the *BRCA2* mutation may have a lifetime risk of 6% to 7% of developing breast cancer (Jain & Gradishar, 2014).

Protective Factors

Certain factors may be protective against the development of breast cancer. Breast feeding for at least 1 year, regular or moderate physical activity and maintaining a healthy body weight are cited as protective (ACS, 2015). Some research suggests that the use of extra virgin olive oil regularly in one's diet may be preventive (Toledo, Salas-Salvad, Donat-Vargas, et al., 2015).

Breast Cancer Prevention Strategies in the Patient who is at High Risk

Patients often over- or underestimate their risk of developing breast cancer. A consultation with a breast specialist is of

TABLE 58-13 Risk Factors for Breast Cancer

Risk Factor	Comments
Female gender	99% of cases occur in women.
Increasing age	Increasing age is associated with an increased risk.
Personal history of breast cancer	Once treated for breast cancer, the risk of developing breast cancer in same or opposite breast is significantly increased.
Family history of breast cancer	Having first-degree relative with breast cancer (mother, sister, daughter) increases the risk twofold; having two first-degree relatives increases the risk fivefold. The risk is higher if the relative was premenopausal at the time of diagnosis. The risk is increased if a father or brother had breast cancer (exact risk is unknown).
Genetic mutation	*BRCA1* and *BRCA2* mutations account for majority of inherited cases of breast cancer (see additional information in text).
Hormonal Factors	
• Early menarche	Before 12 years of age
• Late menopause	After 55 years of age
• Nulliparity	No full-term pregnancies
• Late age at first full-term pregnancy	After 30 years of age
• Hormone therapy (formerly referred to as hormone replacement therapy)	Current or recent use of combined postmenopausal hormone therapy (estrogen and progesterone) Long-term use (several years or more)
Exposure to ionizing radiation during adolescence and early adulthood	The risk is highest if breast tissue was exposed while still developing (during adolescence), such as women who received mantle radiation (to the chest area) for treatment of Hodgkin lymphoma in their younger years.
History of benign proliferative breast disease	Having had atypical ductal or lobular hyperplasia or lobular carcinoma in situ increases the risk.
Obesity	Obesity and weight gain during adulthood increases the risk of postmenopausal breast cancer. During menopause, estrogen is primarily produced in fat tissue. More fat tissue can increase estrogen levels, thereby increasing breast cancer risk.
High-fat diet	More research is needed.
Alcohol intake (beer, wine, or liquor)	Two to five drinks daily increases the risk about one and a half times.

Adapted from National Comprehensive Cancer Network (NCCN). (2015). Clinical practice guidelines: Breast. Retrieved on 3/7/2016 at: www.nccn.org/professionals/physician_gls/PDF/infections.pdf

paramount importance prior to embarking on any of the prevention strategies that follow. Once patients have an accurate assessment of their risk, along with the knowledge of the pros and cons of each prevention strategy, they can make a decision that is most appropriate for their situation.

Long-Term Surveillance

Long-term surveillance focuses on early detection. As recommended by the ACS (2012), women at high risk for breast cancer benefit from additional screening using MRI along with a yearly mammogram. Clinical breast examinations may be performed twice a year starting as early as 25 years of age. Mammograms may also be performed as early as 25 years of age. Data concerning the effectiveness of BSE are limited. In addition to yearly mammography and MRI, other screening tests, including ultrasonography, may be useful.

Chemoprevention

Chemoprevention is the main modality that aims to prevent the disease. Several national, randomized clinical trials in the past two decades have led to FDA approval of tamoxifen and raloxifene (Evista) as effective chemopreventive agents for use in women who are at high risk (Cummings, Eckert, Krueger, et al., 1999); (Fisher, Constantino, Wickerham, et al., 1998); (Vogel, Costantino, Wickerham, et al., 2006). In addition, anastrozole (Arimidex) and exemestane (Aromasin) are now used for chemoprevention (Comerford, 2015). Nurses can help women who are considering chemoprevention by providing them with information about the benefits, risks, and possible side effects of these medications.

Prophylactic Mastectomy

Prophylactic mastectomy is another primary prevention modality that can reduce the risk of breast cancer by 90% (National Cancer Institute [NCI], 2013) and is sometimes referred to as a "risk-reducing" mastectomy. The procedure consists of a total mastectomy (removal of breast tissue) and is usually accompanied by immediate breast reconstruction. Possible candidates include women with a strong family history of breast cancer, a diagnosis of LCIS or atypical hyperplasia, a mutation in a *BRCA* gene, and previous cancer in one breast. Because of physical and psychological ramifications including anxiety, depression, and altered body image, this procedure should be undertaken only after extensive counseling related to its risks and benefits. The procedure does not confer 100% protection against the development of breast cancer (NCI, 2013).

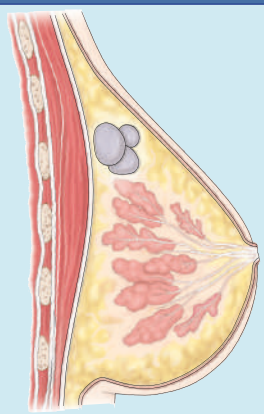
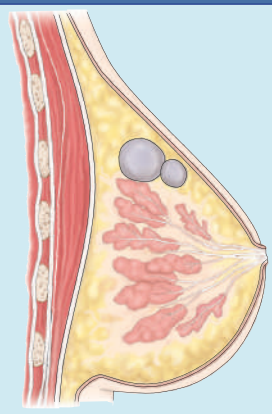
A multidisciplinary approach should be used to help the patient arrive at a decision that is best for her. Consultation with a genetic counselor, plastic surgeon, medical oncologist, and psychiatrist can be invaluable. The patient needs to understand that this surgery is elective and not emergent. The nurse can play a valuable role in providing the patient with information, clarification, and support during the decision-making process.

Clinical Manifestations

Breast cancers can occur anywhere in the breast but are usually found in the upper outer quadrant, where the most breast tissue is located. In general, the lesions are nontender, fixed rather than mobile, and hard with irregular borders. Complaints of diffuse breast pain and tenderness with menstruation are usually associated with benign breast disease. See Table 58-14 for comparison of benign and malignant breast tumors.

TABLE 58-14 Comparison of Various Breast Masses

The most common breast masses are due to cysts, fibroadenomas, or malignancy. Biopsy is usually needed for confirmation, but the following characteristics are diagnostic clues:

Characteristics	Cysts	Fibroadenomas	Malignancy
			
Age	30–55 years, regress after menopause except with use of estrogen therapy	Puberty to menopause	30–90 years; most common, 40–80 years
Number	Single or multiple	Usually single	Usually single
Shape	Round	Round, disc, or lobular	Irregular or stellate
Consistency	Soft to firm, usually elastic	Usually firm	Firm or hard
Mobility	Mobile	Mobile	May be fixed to skin or underlying tissues
Tenderness	Usually tender	Usually nontender	Usually nontender
Retraction signs	Absent	Absent	May be present

Adapted from Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

With the increased use of mammography, more women are seeking treatment at earlier stages of the disease. These women often have no signs or symptoms other than a mammographic abnormality. Some women with advanced disease seek initial treatment after ignoring symptoms. Advanced signs may include skin dimpling, nipple retraction, or skin ulceration.

Assessment

Health History

When a patient presents with a breast problem, the nurse conducts a general health assessment, including history of medical disorders and previous surgery; family history of diseases, particularly cancer; gynecologic and obstetric history; present medications (including prescriptions, vitamins, and herbals); past and present use of hormonal contraceptives, hormone therapy (HT) (formerly referred to as hormone replacement therapy [HRT]), or fertility treatments; and social habits (e.g., smoking, drinking alcohol, illicit drug use). Psychosocial information, such as the patient's marital status, occupation, and availability of resources and support people, is obtained. Any recent x-rays or other diagnostic tests are noted. Focused questions pertaining to the breast disorder are asked concerning the onset of the disorder and the length of time it has been present. In addition, the patient is asked if any masses are palpable and if there is any associated pain, swelling, redness, nipple discharge, or change in the skin. Knowledge and comfort related to breast self-awareness, which can include breast self-examination (BSE), should also be ascertained from the patient.

Physical Assessment: Female Breast

A female breast examination can be conducted during any general physical or gynecologic examination or whenever the patient reports an abnormality. The American Cancer Society (ACS) screening guidelines for early detection of cancer (ACS, 2012) state that an annual clinical breast examination for women 40 years and older is preferable. A clinical breast examination every 1 to 3 years for women between the ages of 20 and 39 years is preferable as part of a periodic health examination (ACS, 2012). A thorough breast examination, including instruction in breast awareness and BSE, takes at least 10 minutes.

Inspection

Examination begins with inspection. The patient is asked to disrobe to the waist and sit in a comfortable position facing the examiner. The breasts are inspected for size and symmetry. A slight variation in the size of each breast is common and generally normal. The skin is inspected for color, venous pattern, thickening, or edema. Erythema (redness) may indicate benign local inflammation or superficial lymphatic invasion by a neoplasm. A prominent venous pattern can signal increased blood supply required by a tumor. Edema and pitting of the skin may result from a neoplasm blocking lymphatic drainage, giving the skin an orange peel appearance (peau d'orange)—a classic sign of advanced breast cancer. Nipple inversion of one or both breasts is not uncommon and is significant only when of recent origin. Ulceration, rashes, or spontaneous nipple discharge requires evaluation. Examples of abnormal breast findings on inspection can be found in Chart. 58-11

Palpation

The breasts are palpated with the patient sitting up (upright) and lying down (supine). In the supine position, the patient's shoulder is first elevated with a small pillow to help balance the breast on the chest wall. Failure to do this allows the breast tissue to slip laterally, and a breast mass may be missed. The entire surface of the breast and the axillary tail is systematically palpated using the flat part (pads) of the second, third, and fourth fingertips, held together, making dime-size circles. The examiner may choose to proceed in a clockwise direction, following imaginary concentric circles from the outer limits of the breast toward the nipple. Other acceptable methods are to palpate from each number on the face of the clock toward the nipple in a clockwise fashion or along imaginary vertical lines on the breast (see Fig. 58-11).

Palpation of the axillary and clavicular areas is easily performed with the patient seated (see Fig. 58-12). To examine the axillary lymph nodes, the examiner gently abducts the patient's arm from the thorax. With the left hand, the patient's right forearm is grasped and supported. The right hand is then free to palpate the axilla. Any lymph nodes that may be lying against the thoracic wall are noted. Normally, these lymph nodes are not palpable, but if they are enlarged, their location, size, mobility, and consistency are noted. During palpation, the examiner notes any patient-reported tenderness or masses. If a mass is detected, it is described by its location (e.g., right breast, 2 cm from the nipple at 2 o'clock position). Size, shape, consistency, border delineation, and mobility are included in the description (Morrow, 2014). The examiner then modifies these steps to use the right hand to grasp the patient's left forearm, and then uses the left hand to palpate the axilla of the left breast.

The breast tissue of the adolescent is usually firm and lobular, whereas that of the postmenopausal woman is more likely to feel thinner and fattier. During pregnancy and lactation, the breasts are firmer and larger with lobules that are more distinct. Hormonal changes cause the areola to darken.

Obesity may have a proinflammatory effect on the breast that can contribute to increased rates of atypia. Atypia in breast ductal lavage and C-reactive protein levels in the nipple are significantly correlated with body mass index (BMI). Excessive body weight, as reflected by a BMI of 25 kg/m^2 or higher, is associated with postmenopausal breast cancer and increases the risk of dying of this disease (Gucalp, Morris, Hudis, et al., 2014).

Cysts are commonly found in women who are menstruating and are usually well defined and freely movable. In the premenstrual period, cysts may be larger and more tender. Malignant tumors, on the other hand, tend to be hard, poorly defined, and nontender. A clinician should further evaluate any abnormalities detected during inspection and palpation.

Diagnostic Evaluation

A wide range of diagnostic studies may be performed in patients with breast conditions. The nurse should educate the patient about the purpose, what to expect, and any possible side effects related to these examinations prior to testing. The nurse should note trends in the patient's test results, because they often provide information about disease progression as well as the patient's response to therapy

Mammography

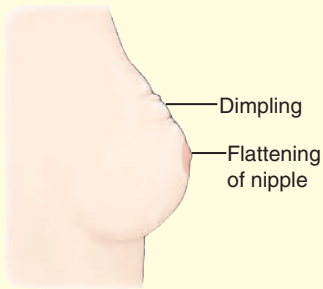
Mammography is a breast imaging technique used to visualize the breast to detect small abnormalities that could suggest malignant or benign disease (Fischbach & Dunning, 2015). The procedure takes about 15 minutes and can be performed in a

Chart 58-11 ASSESSMENT

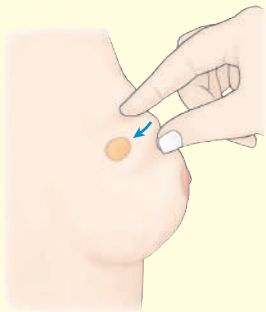
Abnormal Assessment Findings During Inspection of the Breasts

Retraction Signs

- Signs include skin dimpling, creasing, or changes in the contour of the breast or nipple
- They may be secondary to contraction of fibrotic tissue that can occur with underlying malignancy
- They may be secondary to scar tissue formation after breast surgery
- Retraction signs may appear only with position changes



Retraction signs


Retraction with compression

Increased Venous Prominence

- Unilateral localized increase in venous pattern associated with malignant tumors
- Normal with bilateral and symmetrical breast enlargement associated with pregnancy and lactation


Increased venous prominence

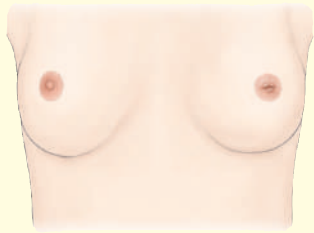
Peau d'Orange (Edema)

- Associated with inflammatory breast cancer
- Caused by interference with lymphatic drainage
- Breast skin has orange peel appearance
- Skin pores enlarge
- May be noted on the areola
- Skin becomes thick, hard, and immobile


Peau d'orange

Nipple Inversion

- Considered normal if long-standing
- Associated with fibrosis and malignancy if recent development


Nipple inversion

Paget Disease (Malignancy of Mammary Ducts)

- Early signs—erythema of nipple and areola
- Late signs—thickening, scaling, and erosion of the nipple and areola


Paget's disease

hospital radiology department or independent imaging center. Two views are taken of each breast. The breast is mechanically compressed from top to bottom (craniocaudal view) and side to side (mediolateral oblique view) (see Fig. 58-13). Women may experience some discomfort because maximum compression is necessary for proper visualization. The new mammogram is compared with previous mammograms, and any changes may indicate a need for further investigation. Mammography may detect a breast tumor before it is clinically palpable (i.e., smaller than 1 cm); however, it has limitations (Fischbach & Dunning, 2015). The false-negative rate ranges between 5% and 10% (Helvie & Patterson, 2014). Younger women, or those taking HTs, may have dense breast tissue, making it more difficult to detect lesions with mammography.

Patients scheduled for a mammogram may voice concern about exposure to radiation. The radiation exposure is equivalent to about 1 hour of exposure to sunlight, so patients would have to have many mammograms in a year to increase their cancer risk. To ensure that a mammogram is reliable, it is important that a woman find a reputable facility.

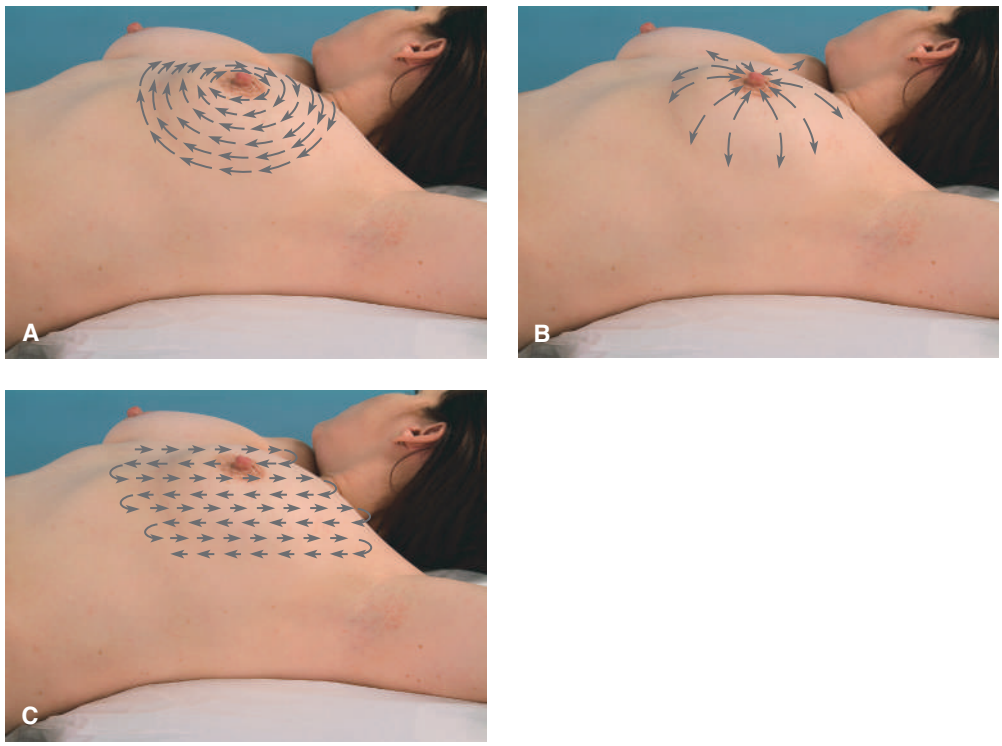


Figure 58-11 • Breast examination with the woman in a supine position. The entire surface of the breast is palpated from the outer edge of the breast to the nipple; palpation patterns are circular or clockwise **(A)**, wedge **(B)**, and vertical strip **(C)**.

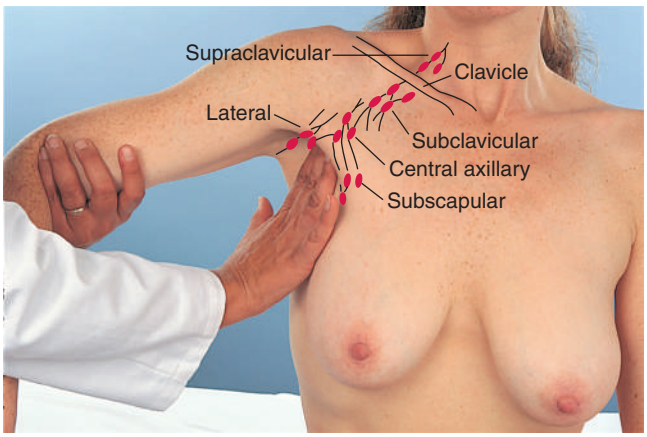


Figure 58-12 • Palpating axillary nodes in breast examination.

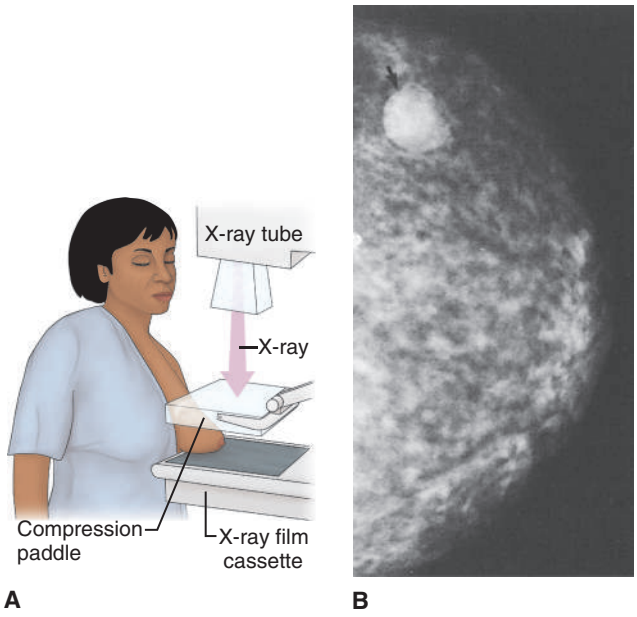


Figure 58-13 • The mammography procedure **(A)** relies on x-ray imaging to produce the mammogram **(B)**, which in this case reveals a breast lump.

In 2015, the ACS changed the mammography recommendations to state that healthy women should have mammography every year beginning at age 45 years (ACS, 2015). Women 55 and older may continue yearly screening or transition to every 2 years. This change was based on calculations that starting annual screening mammography later and getting it less often would cause less harm and be as safe as starting it earlier and getting it more often. Screening every other year may, however, result in a missed diagnosis and a small increase in the probability of being diagnosed with later-stage cancer (Kerlikowske, 2015).

The ACS, however, continues to recommend that women 45 years and older have a mammogram every year and that they continue to do so for as long as they do not have serious, chronic health problems such as congestive heart failure, end-stage kidney disease, chronic obstructive pulmonary disease, and moderate to severe dementia. Age alone should not be the reason to stop having regular mammograms (ACS, 2012).

Newer techniques for breast screening include digital mammography and 3D mammography. Digital mammography records x-ray images on a computer instead of on film, thus allowing radiologists to adjust the contrast and focus on an image without having to take additional x-rays. Although the accuracy of both film and digital screening mammography is

similar for most women, digital mammography has been shown to be better at detecting estrogen receptor–negative tumors and cancer in extremely dense breasts. Both of these subgroups are more common in younger women, who may therefore choose digital mammography if they wish to have screening mammography. The 3D mammography obtains multiple projections of the compressed breast and results in fewer call backs for additional imaging (Jochelson, 2014). Computer-aided detection (CAD) is an option for radiologists and can be helpful in finding abnormal areas that should be checked more closely for early cancers. Refinements and improvements have been made to CAD software with a focus on increasing sensitivity for masses and reducing false-positive rates.

Contrast Mammography

A contrast mammography (i.e., ductogram, galactogram) is a diagnostic procedure that involves injection of less than 1 mL of radiopaque material through a cannula inserted into a ductal opening on the areola, which is followed by a mammogram (Fischbach & Dunning, 2015). It is performed to evaluate an abnormality within the duct when the patient has bloody nipple discharge on expression, spontaneous nipple discharge, or a solitary dilated duct noted on mammography.

Ultrasonography

Ultrasonography (ultrasound) is used as a diagnostic adjunct to mammography to help distinguish fluid-filled cysts from other lesions. A thin coating of lubricating jelly is spread over the area to be imaged. A transducer is then placed on the breast. The transducer transmits high-frequency sound waves through the skin toward the area of concern. The sound waves that are reflected back form a two-dimensional image, which is then displayed on a computer screen. No radiation is emitted during the procedure. Ultrasound is also used as an adjunct to mammography in women with dense breast tissue.

Ultrasonography has advantages and disadvantages. Although it can diagnose cysts with great accuracy, it cannot definitively rule out malignant lesions. Microcalcifications, which are detectable on mammography, cannot be identified on ultrasonography. Finally, examination techniques and interpretation criteria are not standardized.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) of the breast is a highly sensitive test that has become a useful diagnostic adjunct to mammography. A magnet is linked to a computer that creates detailed images of the breast without exposure to radiation. An intravenous (IV) injection of gadolinium, a contrast dye, is given to improve visibility. The patient lies face down, and the breast is placed through a depression in the table. A coil is placed around the breast, and the patient is placed inside the MRI machine. The entire procedure takes about 30 to 40 minutes.

Breast MRI is useful for evaluation of contralateral disease, invasive lobular carcinoma, and assessment of chemotherapeutic response. The ACS recommends an annual MRI scan in addition to mammography in women at high risk for breast cancer (i.e., those with greater than 20% lifetime risk). Candidates include women who have a *BRCA1* or *BRCA2* mutation, a first-degree relative with either of these mutations, certain rare genetic syndromes, or radiation to the chest between 10 and 30 years of age (ACS, 2012). MRI should be used in addition to mammography, not instead of it.

Some disadvantages of MRI include high cost, variations in technique and interpretation, and the potential for patient claustrophobia. The procedure cannot always accurately distinguish between malignant and benign breast conditions, so false positive results may occur. MRI is contraindicated in patients with implantable metal devices (e.g., aneurysm clips, pacemakers, ports of tissue expanders) because of the metallic force. Foil-backed medication patches (e.g., nicotine, nitroglycerin, fentanyl) must be removed prior to MRI to avoid burns to the skin.

Procedures for Tissue Analysis

Percutaneous Biopsy

Percutaneous biopsy is performed on an outpatient basis to sample palpable and nonpalpable lesions. Less invasive than a surgical biopsy, percutaneous biopsy is a needle or core biopsy that obtains tissue by making a small puncture in the skin. Table 58-15 outlines the different types of biopsies that can be performed to obtain a tissue diagnosis.

Nursing Alert: It is important to understand the differences between common procedures used for patients with breast disorders. Mammography is used to detect breast abnormalities, whereas biopsy is performed to confirm a diagnosis of breast cancer.

Fine-Needle Aspiration

Fine-needle aspiration (FNA) is a biopsy technique that is generally well tolerated by most women. A local anesthetic may or may not be used. A small-gauge needle (25 or 22 gauge) attached to a syringe is inserted into the mass or area of nodularity. Suction is applied to the syringe, and multiple passes are made through the mass. A simple cyst often disappears on aspiration, and the fluid is usually discarded. If no fluid is obtained, any cellular material obtained in the hub of the needle is spread on a glass slide or placed in a preservative and sent to

TABLE 58-15 Types of Breast Biopsies

Procedure	Palpable Mass	Health Professional Who Performs Procedure	Nature of Breast Tissue Removed
Fine-needle aspiration	Yes	Surgeon	Cellular material
Core needle biopsy	Yes	Surgeon	Tissue core
Stereotactic core biopsy	No	Radiologist	Tissue core
Ultrasound-guided core biopsy	No	Radiologist	Tissue core
Magnetic resonance imaging (MRI)-guided core biopsy	No	Radiologist	Tissue core
Excisional biopsy	Yes	Surgeon	Entire mass
Incisional biopsy	Yes	Surgeon	Tissue core
Wire needle localization biopsy; may be guided by mammogram, ultrasound, or MRI	No	Radiologist inserts wire; surgeon performs biopsy	Entire mass

the laboratory for analysis (CancerQuest, 2015). For nonpalpable masses, the same procedure can be performed by a radiologist using ultrasound guidance (ultrasound-guided FNA).

FNA is less expensive than other diagnostic methods, and results are usually available quickly. However, false-negative or false-positive results are possible, and appropriate follow-up depends on the clinical judgment of the treating physician.

Core Needle Biopsy

Core needle biopsy is similar to FNA, except a larger-gauge needle is used (usually 14 gauge). A local anesthetic is applied, and tissue cores are removed via a spring-loaded device. This procedure allows for a more definitive diagnosis than FNA, because actual tissue, not just cells, is removed. It is often performed for relatively large tumors that are close to the skin surface, but is also utilized for smaller, deeper lesions that are visible on ultrasound.

Stereotactic Core Biopsy

Stereotactic core biopsy is performed on nonpalpable lesions detected by mammography. The patient lies prone on the stereotactic table. The breast is suspended through an opening in the table and compressed between two x-ray plates. Images are then obtained using digital mammography. The exact coordinates of the lesion to be sampled are located with the aid of a computer. Next, a local anesthetic is injected into the entry site on the breast. A small nick is made in the skin, a core needle is inserted, and samples of the tissue are taken for pathologic examination. Often, several passes are taken to ensure that the lesion is well sampled. Post-biopsy images are then taken to check that sampling has been adequate. A small titanium clip is almost always placed at the biopsy site so that the site can easily be located if further treatment is indicated.

Stereotactic biopsy is quite accurate and often allows the patient to avoid a surgical biopsy. However, there is a small false-negative rate. Appropriate follow-up depends on the final pathologic diagnosis and the clinical judgment of the primary provider. The use of a titanium clip does not preclude subsequent MRIs.

Ultrasound-Guided Core Biopsy

The principles for ultrasound-guided core biopsy are similar to those of stereotactic core biopsy, but by using ultrasound guidance, computer coordination and mammographic compression are not necessary. An ultrasound-guided core biopsy does not use radiation and is also usually faster and less expensive than stereotactic core biopsy.

Magnetic Resonance Imaging–Guided Core Biopsy

MRI-guided core biopsy can be performed by a radiologist and technologist when the abnormal area in the breast is too small to be felt but is visible on MRI.

Surgical Biopsy

Surgical biopsy is usually performed using local anesthesia and intravenous (IV) sedation. After an incision is made, the lesion is excised and sent to a laboratory for pathologic examination. Surgical biopsy is usually preceded by a core biopsy or stereotactic biopsy for pathologic determination.

Types of Surgical Breast Biopsy

Excisional Biopsy

Excisional biopsy is the standard procedure for complete pathologic assessment of a palpable breast mass. The entire mass, plus a margin of surrounding tissue, is removed. This type of biopsy may also be referred to as a lumpectomy. Depending on the clinical situation, a frozen-section analysis of the specimen may be performed at the time of the biopsy by the pathologist, who does an immediate reading intraoperatively and provides a provisional diagnosis. This can help confirm a diagnosis in a patient who has had no previous tissue analysis performed.

Incisional Biopsy

Incisional biopsy surgically removes a portion of a mass. This is performed to confirm a diagnosis and to conduct special studies (e.g., ER/PR, HER-2/neu [also referred to as ERBB2]; see later discussion for explanation of these terms) that will aid in determining treatment, which is discussed later in this chapter. Complete excision of the area may not be possible or immediately beneficial to the patient, depending on the clinical situation. This procedure is often performed on women with locally advanced breast cancer or on women with suspected cancer recurrence, whose treatment may depend on the results of these special studies. However, pathologic information may be easily obtained from core needle biopsy, and incisional biopsy is becoming less common.

Wire Needle Localization

Wire needle localization is a technique used to locate nonpalpable masses or suspicious calcium deposits detected on a mammogram, ultrasound, or MRI that require an excisional biopsy. The radiologist inserts a long, thin wire through a needle, which is then inserted into the area of abnormality using x-ray or ultrasound guidance (whichever imaging technique originally identified the abnormality). The wire remains in place after the needle is withdrawn to ensure the precise location. The patient is then taken to the operating room, where the surgeon follows the wire to the tip and excises the area.

Nursing Management

During the preoperative or preprocedure visit, the nurse assesses the patient for any specific educational, physical, or psychosocial needs. This can be accomplished by reviewing the medical and psychosocial history and encouraging the patient to verbalize fears, concerns, and questions. Patients are often worried not only about the procedure but also about the potential implications of the pathology results. Providing a thorough explanation about what to expect in a supportive manner can help alleviate anxiety. Patients often have difficulty absorbing all the information given to them; therefore, written materials to take home are often provided to reinforce and clarify education.

The nurse instructs the patient to discontinue any agents that can increase the risk of bleeding, including products containing aspirin, nonsteroidal anti-inflammatory drugs, vitamin E supplements, herbal substances (such as ginkgo biloba and garlic supplements). Patients on prescription anticoagulants may need to check with the prescriber prior to temporary cessation for the procedure, as biopsies done without cessation of these drugs can result in prolonged bleeding and hematomas. The patient may be instructed not to eat or drink for several hours prior to the procedure or after midnight the night before the procedure, depending on the type of biopsy and anesthesia planned. Most breast biopsy procedures are performed with the use of moderate sedation and local anesthesia.

Immediate assessment after the procedure includes monitoring the effects of the anesthesia and inspecting the surgical dressing for any signs of bleeding. Once the sedation

has worn off, the nurse reviews the care of the biopsy site, pain management, and activity restrictions with the patient. Prior to discharge from the ambulatory surgical center or the office, the patient must be able to tolerate fluids, ambulate, and void. The patient must be accompanied home. The dressing covering the incision is usually removed after 48 hours, but the Steri-Strips, which are applied directly over the incision, should remain in place for approximately 7 to 10 days or until they fall off. The use of a supportive bra following surgery is encouraged to limit movement of the breast and reduce discomfort. A follow-up telephone call from the nurse 24 to 48 hours after the procedure can provide the patient with the opportunity to ask any questions and can be a source of great comfort and reassurance.

Most women return to their usual activities the day after the procedure but are encouraged to avoid jarring or high-impact activities for 1 week to promote healing of the biopsy site. Discomfort is usually minimal, and most women find acetaminophen/paracetamol (Tylenol) sufficient for pain relief, although a mild opioid analgesic agent may be prescribed if needed.

Follow-up after the biopsy includes a return visit to the surgeon for discussion of the final pathology report and assessment of the healing of the biopsy site. Depending on the results of the biopsy, the nurse's role varies. If the pathology report is benign, the nurse reviews incision care and explains what the patient should expect as the biopsy site heals (i.e., changes in sensation may occur weeks or months after the biopsy due to nerve injury within the breast tissue). If a diagnosis of cancer is made, the nurse's role changes dramatically.

Staging

Staging involves classifying the cancer by the extent of the disease in the body. It is based on whether the cancer is invasive or noninvasive, the size of the tumor, how many lymph nodes are involved, and if it has spread to other parts of the body. The stage of a cancer is one of the most important factors in determining prognosis and treatment options. The most common system used to describe the stages of breast cancer is the American Joint Committee on Cancer (AJCC) TNM (tumor, nodes, metastasis) system (see Chart 58-3). Other factors considered in staging include hormone receptors and genetic mutations.

Prognosis

Several different factors must be taken into consideration when determining the prognosis of a patient with breast cancer. Two of the most important factors are tumor size and whether the tumor has spread to the lymph nodes under the arm (axilla).

In general, the smaller the tumor appears, the better the prognosis. A tumor starts with a genetic alteration in a single cell and takes time to divide and double in size. A carcinoma may double in size 30 times to become 1 cm or larger, at which point it becomes clinically apparent. Doubling time varies, but breast tumors are often present for several years before they become palpable. Nurses can reassure patients that once breast cancer is diagnosed, they have a safe period of several weeks to make decisions regarding treatment; however, a lengthy delay is not advisable.

Prognosis also depends on the extent of spread of the breast cancer. The 5-year survival rate is approximately 88% for a stage I breast cancer and 15% for a stage IV breast cancer (ACS, 2015). The most common route of regional spread is to the axillary lymph nodes. Other sites of lymphatic spread include the internal mammary and supraclavicular nodes (see Fig. 58-14). Distant metastasis can affect any organ, but the most common sites are bone, lung, liver, pleura, adrenals, skin, and brain (ACS, 2015).

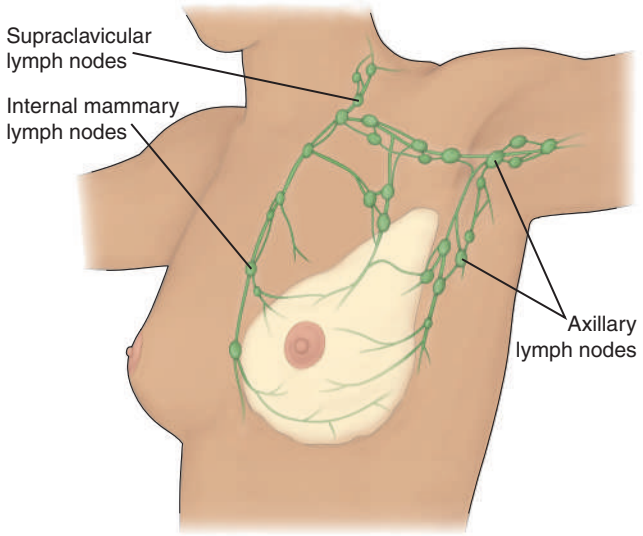


Figure 58-14 • Lymphatic drainage of the breast.

Chart 58-12

Pathologic Factors Associated with Favorable Prognosis for Breast Cancer

- Noninvasive tumors or invasive tumors <1 cm
- Negative axillary lymph nodes
- Estrogen receptor (ER) and progesterone receptor (PR) proteins
- Well-differentiated tumors
- Low expression of HER-2/neu oncogene (also known as ERBB2)
- No vascular or lymphatic invasion
- Diploid tumors with low S-phase fraction

Adapted from U.S. Department of Health and Human Services, Public Health Service. (2012). What you need to know about breast cancer. Bethesda, MD: National Institutes of Health.

In addition to the type of breast cancer and the stage, other factors may help determine prognosis (see Chart 58-12). Excessive number of copies of certain genes (amplification) or excessive amounts of their protein product (overexpression) may represent a poorer prognosis. The HER-2/neu (also known as ERBB2) oncogene is the classic example; approximately 25% of invasive breast cancers, which typically involve the more aggressive tumors, have amplification or overexpression of this gene (Press & Ma, 2015). The proliferative rate or rapidity in growth rate (S-phase fraction) and DNA content (ploidy) of a tumor are factors that are also associated with overall survival rate.

Surgical Management

The main goal of surgery is to gain local control of the disease. With breast cancer being diagnosed today at earlier stages, options for less invasive, breast conserving surgical procedures are available. Surgical treatment options for noninvasive and invasive breast cancer are summarized in Table 58-16.

Modified Radical Mastectomy

Modified radical mastectomy is performed to treat invasive breast cancer. The procedure involves removal of breast tissue,

TABLE 58-16 Surgical Treatment Options for Noninvasive and Invasive Breast Cancer

Noninvasive Breast Cancer	Invasive Breast Cancer
Breast conservation[a] alone	Breast conservation[a] with one of the following: Sentinel lymph node biopsy Axillary lymph node dissection
Total mastectomy alone	Total mastectomy with sentinel lymph node biopsy or Modified radical mastectomy

[a]Breast conservation treatment includes lumpectomy, wide excision, partial or segmental mastectomy, and quadrantectomy. These are relatively synonymous terms that describe removal of varying amounts of breast tissue.

including the nipple–areola complex. In addition, a portion of the axillary lymph nodes are also removed in axillary lymph node dissection (ALND). If immediate breast reconstruction is desired, the patient is referred to a plastic surgeon prior to the mastectomy so that she has the opportunity to explore all available options. In modified radical mastectomy, the pectoralis major and pectoralis minor muscles are left intact, unlike in radical mastectomy, in which the muscles are removed.

Total Mastectomy

Like modified radical mastectomy, total mastectomy (i.e., simple mastectomy) also involves removal of the breast and nipple–areola complex but does not include ALND. Total mastectomy may be performed in patients with noninvasive breast cancer (e.g., DCIS), which does not have a tendency to spread to the lymph nodes. It may also be performed prophylactically in patients who are at high risk for breast cancer (e.g., LCIS, *BRCA* mutation). A total mastectomy may also be performed in conjunction with sentinel lymph node biopsy (SLNB) for patients with invasive breast cancer.

Breast Conservation Treatment

The goal of breast conservation treatment (i.e., lumpectomy, wide excision, partial or segmental mastectomy, quadrantectomy) is to excise the tumor in the breast completely and obtain clear margins while achieving an acceptable cosmetic result. If the procedure is being performed to treat a noninvasive breast cancer, lymph node removal is not necessary. For an invasive breast cancer, lymph node removal (SLNB or ALND) is indicated. The lymph nodes are removed through a separate semicircular incision in the axilla.

Sentinel Lymph Node Biopsy

The status of the lymph nodes is the most important prognostic factor in breast cancer. The SLNB is a less invasive alternative to ALND and is considered a standard of care for the treatment of early-stage breast cancer. ALND is associated with potential morbidity, including lymphedema, cellulitis, decreased arm mobility, and sensory changes. Studies suggest that SLNB is highly accurate and is associated with a local recurrence rate similar to that of ALND (Chung & Giuliano, 2014). Table 58-17 compares SLNB and ALND.

The sentinel lymph node, which is the first node (or nodes) in the lymphatic basin that receives drainage from the primary tumor in the breast, is identified by injecting a radioisotope and/or blue dye into the breast; the radioisotope or dye then travels via the lymphatic pathways to the node. In SLNB, the surgeon uses a handheld probe to locate the sentinel lymph node, excises it, and sends it for pathologic analysis, which is often performed immediately during the surgery using frozen-section analysis. If the sentinel lymph node is positive, the surgeon can proceed with an immediate ALND, thus sparing the patient a return trip to the operating room and additional anesthesia. (The patient could also return for additional surgery at a later time.) If the sentinel lymph node is negative, a standard ALND is not needed, thus sparing the patient the possible complications of the procedure. After the procedure is complete, all specimens are sent to pathology for more thorough analysis.

Nursing Management

Patients who undergo SLNB in conjunction with breast conservation treatments are generally discharged the same day. Patients who undergo SLNB with total mastectomy usually stay in the hospital overnight, possibly longer if breast reconstruction is being performed. The patient must be informed that although frozen-section analysis is highly accurate, false-negative results can occur. A negative sentinel lymph node on frozen-section analysis may show metastatic disease on subsequent analysis, indicating that ALND is still necessary. The patient should also be reassured that the radioisotope and blue dye are generally safe. The nurse informs patients that they may notice a blue-green discoloration in the urine or stool for the first 24 hours as the blue dye is excreted. The incidence of lymphedema, decreased arm mobility, and seroma formation (collection of serous fluid) in the axilla is generally low, but the patient

TABLE 58-17 Comparison of Sentinel Lymph Node Biopsy and Axillary Lymph Node Dissection

Sentinel Lymph Node Biopsy	Axillary Lymph Node Dissection
Shorter operating room time (~15–30 minutes)	Longer operating room time (~60–90 minutes)
No surgical drain	Surgical drain
Local anesthesia with IV moderate sedation as outpatient surgery (unless being performed in conjunction with total mastectomy)	General anesthesia; usually overnight admission (sometimes done as outpatient surgery)
Lymphedema incidence approximately 0–7%	Lymphedema incidence approximately 0–20%
Presence of neuropathic sensations postoperatively (prevalence lower than after axillary lymph node dissection)	Presence of neuropathic sensations postoperatively
Decreased range of motion in affected arm unlikely postoperatively but may occur	Decreased range of motion likely postoperatively
Seroma (collection of serous fluid in the axilla) may occur postoperatively.	Seroma may occur postoperatively

should be prepared for these possibilities. Women who have SLNB alone have neuropathic sensations similar to those who undergo ALND, although the prevalence and severity of these sensations and the resulting distress are lower with SLNB (Chung & Giuliano, 2014).

The nurse must not overlook the psychosocial needs of the patient who has undergone SLNB. Although SLNB is a less invasive procedure than ALND and results in a shorter recovery period, a patient who has undergone SLNB also has many difficult issues surrounding her breast cancer diagnosis and treatment. The nurse must listen, provide emotional support, and refer the patient to appropriate specialists when indicated.

NURSING PROCESS

The Patient Undergoing Surgery for Breast Cancer

Assessment

The health history is a valuable tool to assess the patient's reaction to the diagnosis and her ability to cope with it. Pertinent questions include the following:

- How is the patient responding to the diagnosis?
- What coping mechanisms does she find most helpful?
- What psychological or emotional supports does she have and use?
- Is there a partner, family member, or friend available to assist her in making treatment choices?
- What are her educational needs?
- Is she experiencing any discomfort?

Diagnosis

Preoperative Nursing Diagnoses

Based on the assessment data, major preoperative nursing diagnoses may include the following:

- Deficient knowledge about the planned surgical treatments
- Anxiety related to the diagnosis of cancer
- Fear related to specific treatments and body image changes
- Risk for defensive or ineffective coping related to the diagnosis of breast cancer and related treatment options
- Decisional conflict related to treatment options

Postoperative Nursing Diagnoses

Based on the assessment data, major postoperative nursing diagnoses may include the following:

- Acute pain and discomfort related to surgical procedure
- Peripheral neurovascular dysfunction related to nerve irritation in affected arm, breast, or chest wall
- Disturbed body image related to loss or alteration of the breast
- Risk for ineffective coping related to the diagnosis of cancer and surgical treatment
- Self-care deficit related to partial immobility of upper extremity on operative side
- Risk for sexual dysfunction related to loss of body part, change in self-image, and fear of partner's responses
- Deficient knowledge: drain management after breast surgery, arm exercises to regain mobility of affected extremity, hand and arm care after ALND

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Lymphedema
- Hematoma/seroma formation
- Infection

Planning and Goals

The major goals may include increased knowledge about the disease and its treatment; reduction of preoperative and postoperative fear, anxiety, and emotional stress; improvement of decision-making ability; pain management; neurovascular function management; maintenance of a positive body image; improvement in coping abilities; increased self-care abilities; improvement in sexual function; and the absence of complications.

Preoperative Nursing Interventions

Providing Education and Preparation about Surgical Treatments

Patients with newly diagnosed breast cancer are expected to absorb an abundance of new information during a very emotionally difficult time, and this may lead to difficulty in making treatment decisions. The nurse plays a key role in reviewing treatment options by reinforcing information provided to the patient and answering any questions. The nurse fully prepares the patient for what to expect before, during, and after surgery. Patients undergoing breast conservation with ALND, or a total or modified radical mastectomy, generally remain in the hospital overnight (or longer if they have immediate reconstruction). Surgical drains will be inserted in the mastectomy incision and in the axilla if the patient undergoes ALND. A surgical drain is generally not needed after SLNB. The patient should be informed that she will go home with the drain(s) and that complete instructions about drain care will be provided prior to discharge. In addition, the patient should be informed that she will often have decreased arm and shoulder mobility after ALND and that she will be shown range-of-motion exercises prior to discharge. The patient should also be reassured that appropriate analgesia and comfort measures will be provided to alleviate any postoperative discomfort.

Reducing Fear and Anxiety and Improving Coping Ability

The nurse helps the patient cope with the physical and emotional effects of surgery. Many fears may emerge during the preoperative phase. These can include fear of pain, mutilation (after mastectomy), and loss of sexual attractiveness; concern about inability to care for oneself and one's family; concern about taking time off from work; and coping with an uncertain future. Providing the patient with realistic expectations about the healing process and expected recovery can help alleviate fears. Maintaining open communication and assuring the patient that she can contact the nurse at any time with questions or concerns can be a source of comfort. The patient should also be made aware of available resources at the treatment facility as well as in the breast cancer community such as social workers, psychiatrists, and support groups. Some women find it helpful and reassuring to talk to a survivor of breast cancer who has undergone similar treatments.

Promoting Decision-Making Ability

The patient may be eligible for more than one therapeutic approach; she may be presented with treatment options and then asked to make a choice. This can be very frightening for some patients, and they may prefer to have someone else make the decision for them (e.g., surgeon, family member). The nurse can be instrumental in ensuring that the patient and family

members truly understand their options. The nurse can then help the patient weigh the risks and benefits of each option. The patient may be presented with the option of having breast conservation treatment followed by radiation or a mastectomy. The nurse can explore the issues with the patient by asking questions such as the following:

- How do you think you might feel about losing your breast?
- Are you considering breast reconstruction?
- If you choose to retain your breast, would you consider undergoing radiation treatments 5 days a week for 5 to 6 weeks?

Questions such as these can help the patient focus. Once the patient's decision is made, it is very important to support it.

Postoperative Nursing Interventions

Relieving Pain and Discomfort

Many patients tolerate breast surgery well and have minimal pain during the postoperative period. This is particularly true of less invasive procedures such as breast conservation treatment with SLNB. However, all patients must be carefully assessed, because individual patients can have varying degrees of pain. Patients who have had more invasive procedures, such as a modified radical mastectomy with immediate reconstruction, may have considerably more pain. All patients are discharged home with analgesic medication (e.g., oxycodone and acetaminophen/paracetamol [Percocet]) and are encouraged to take it if needed. An over-the-counter analgesic agent such as acetaminophen/paracetamol may provide sufficient relief. Patients sometimes complain of a slight increase in pain after the first few days of surgery; this may occur as patients regain sensation around the surgical site and become more active. However, patients who report more than moderate pain must be evaluated to rule out any potential complications such as infection or hematoma. Postoperative pain may be more common in patients who have had axillary dissection and correlates with the number of nodes removed (Cherny & Truong, 2014). Alternative methods of pain management, such as taking warm showers (if permitted by the surgeon) and using distraction methods (e.g., guided imagery), may also be helpful. See Chapter 9 for further discussion of methods that relieve pain.

Managing Postoperative Sensations

Because nerves in the skin and axilla are often ligated or injured during breast surgery, patients experience a variety of sensations. Common sensations include tenderness, soreness, numbness, tightness, pulling, and twinges. These sensations may occur along the chest wall, in the axilla, and along the inside aspect of the upper arm. After mastectomy, some patients experience phantom sensations and report a feeling that the breast or nipple is still present. Overall, patients do not find these sensations severe or distressing. Sensations usually persist for several months and then begin to diminish, although some may persist for as long as 5 years and possibly longer. Patients should be reassured that this is a normal part of healing and that these sensations are not indicative of a problem.

Promoting Positive Body Image

Patients who have undergone mastectomy may find it difficult to view the surgical site for the first time. No matter how prepared the patient may think she is, the appearance of an absent breast can be very emotionally distressing. Ideally, the patient sees the incision for the first time when she is with the nurse or another health care provider who is available for support.

The nurse first assesses the patient's readiness and provides gentle encouragement. It is important to maintain the patient's privacy while assisting her as she views the incision; this allows her to express feelings safely to the nurse. Asking the patient what she perceives, acknowledging her feelings, and allowing her to express her emotions are important nursing actions. Reassuring the patient that her feelings are a normal response to breast cancer surgery may be comforting. If the patient has not had immediate reconstruction, providing her with a temporary breast form or soft padding to place in her bra on discharge can help alleviate feelings of embarrassment or self-consciousness.

Promoting Positive Adjustment and Coping

Providing ongoing assessment of how the patient is coping with her diagnosis of breast cancer and her surgical treatment is important in determining her overall adjustment. Assisting the patient in identifying and mobilizing her support systems can be beneficial to her well-being. The patient's spouse or partner may also need guidance, support, and education. Encouraging the patient to discuss issues and concerns with other patients who have had breast cancer may help her to understand that her feelings are normal and that other women who have had breast cancer can provide invaluable support and understanding.

The patient may also have considerable anxiety about the treatments that will follow surgery (i.e., chemotherapy and radiation) and their implications. Providing her with information about the plan of care and referring her to the appropriate members of the health care team also promote coping during recovery. Some women require additional support to adjust to their diagnosis and the changes that it brings. If a woman displays ineffective coping, consultation with a mental health provider may be indicated. Research suggests that nurse navigators can help those undergoing breast biopsy to cope (Harding, 2015) (see Chart 58-13).

Improving Sexual Function

Once discharged from the hospital and feeling well, most patients are physically allowed to engage in sexual activity, if interested. However, any change in the patient's body image, self-esteem, or the response of her partner may increase her anxiety level and affect sexual function. Some partners may have difficulty looking at the incision, whereas others may be completely unaffected. Encouraging the patient to openly discuss how she feels about herself and about possible reasons for a decrease in libido (e.g., fatigue, anxiety, self-consciousness) may help clarify issues for her. Helpful suggestions for the patient may include varying the time of day for sexual activity (when the patient is less tired), assuming positions that are more comfortable, and expressing affection using alternative measures (e.g., hugging, kissing, manual stimulation).

Most patients and their partners adjust with minimal difficulty if they openly discuss their concerns. However, if issues cannot be resolved, a referral for counseling (e.g., psychologist, psychiatrist, psychiatric clinical nurse specialist, social worker, sex therapist) may be helpful. The ambulatory care nurse in the outpatient clinic or hospital should inquire whether the patient who was sexually active prior to surgery has resumed activities, because many patients are reluctant or embarrassed to bring this topic up themselves.

Monitoring and Managing Potential Complications

Lymphedema. Lymphedema is a complication characterized by a chronic swelling of an extremity due to interrupted lymphatic circulation. The swelling is due to the accumulation

Chart 58-13 NURSING RESEARCH PROFILE

Nurse Navigators and Breast Biopsy

Harding, M. (2015). Effect of nurse navigation on patient care satisfaction and distress associated with breast biopsy. Clinical Journal Oncology Nursing, 19(1), E15–E20.

Purpose

This study was conducted to evaluate the impact of nurse navigation on satisfaction with care and level of stress in patients having a breast biopsy.

Design

This study used a descriptive cross sectional survey design. Two outpatient radiology sites were utilized including a community center and a breast center in Appalachia, following institutional review board (IRB) approval. The breast center used a multidisciplinary approach coordinated by a nurse navigator; the community center had no nurse navigator. Patients were invited to participate in the study prior to their biopsy. Study instruments included the Hospital Anxiety and Depression Scale (HADS), the State Trait Anxiety Inventory Scale (STAI-S), and the Patient Satisfaction Questionnaire (PSQ-18). Descriptive statistics were used to analyze demographic characteristics, *t* tests, chi square tests and Pearson correlations were used to examine variables.

Findings

One hundred and thirty seven women completed the study instruments at home following a core needle biopsy. The majority (68%) of the women were older than 50 years of age. Women who received navigation services ($N = 85$) had lower scores on all three distress measures (HAD-A [anxiety subscale], HAD-D [depression subscale], & STAI-S), with significantly lower anxiety levels on the HADS-A. There were no significant differences in patient satisfaction between the two groups. Sixty-six women (48%) sought outside information regarding an aspect of the diagnostic experience. Women not receiving navigation services were significantly more likely to seek outside information ($X^2 = 7.949$; $p < 0.01$), with a majority (67%) using the internet as an information source.

Nursing Implications

This study suggests that nurse navigators providing information and support can improve decision making and help prepare women for explanatory educational sessions with radiologists and surgeons. Nurses working with women having a breast biopsy should also keep in mind that this study reported women seeking additional information commonly used internet sources.

of protein-rich fluid in the interstitial space and is a somewhat common postoperative complication after ALND. It often affects both the breast and ipsilateral limb. It is associated with a painful swelling of the arm as well as weakness, shoulder pain, and tingling sensations in the arm and shoulder. Research results suggest that within 5 years of ALND, there is a 20% risk of lymphedema. Because sentinel lymph node dissection (SLND) involves more focused surgery and less disruption of the axilla, the risk is only up to 7% within 5 years. Risk factors for lymphedema in mixed-age groups include ALND, concomitant radiation therapy, increased age, presence of a concomitant infection, pre-existing cardiovascular conditions, and obesity (McLaughlin, 2014).

Lymphedema results if functioning lymphatic channels are inadequate to ensure a return flow of lymph fluid to the general circulation. After axillary lymph nodes are removed, collateral circulation must assume this function. Transient edema in the postoperative period occurs until collateral circulation has completely taken over this function, which generally occurs within a month. Performing prescribed exercises, elevating the arm above the heart several times a day, and gentle muscle pumping (making a fist and releasing) can help reduce the transient edema. The patient needs reassurance that this transient swelling is not lymphedema.

Once lymphedema develops, it tends to be chronic, so preventive strategies are vital. After ALND, the patient is taught hand and arm care to prevent injury or trauma to the affected extremity, thus decreasing the likelihood for development of lymphedema (see Chart 58-14). The patient is instructed to follow these guidelines for the rest of her life. She is also instructed to contact her primary provider immediately if she suspects that she has lymphedema, because early intervention provides the best chance for control. If allowed to progress without treatment, the swelling can become more difficult to manage. Treatment may consist of a course of antibiotic agents if an infection is present. A referral to a rehabilitation specialist

Chart 58-14 PATIENT EDUCATION

Hand and Arm Care After Axillary Lymph Node Dissection

The nurse instructs the patient to:

- Avoid blood pressures, injections, and blood draws in affected extremity.
- Use sunscreen (higher than 15 SPF) for extended exposure to sun.
- Apply insect repellent to avoid insect bites.
- Wear gloves for gardening.
- Use cooking mitt for removing objects from oven.
- Avoid cutting cuticles; push them back during manicures.
- Use electric razor for shaving armpit.
- Avoid lifting objects heavier than 2.3 – 4.5 kg.
- If a trauma or break in the skin occurs, wash the area with soap and water, and apply an over-the-counter antibacterial ointment (Bacitracin or Neosporin). Observe the area and extremity for 24 hours; if redness, swelling, or a fever occurs, call the surgeon or nurse.

(e.g., occupational or physical therapist) may be necessary for a compression sleeve or glove, exercises, manual lymph drainage, and a discussion of ways to modify daily activities to avoid worsening lymphedema. Ongoing research is seeking to identify which lymph nodes drain the arm before surgery so that they can be preserved when possible, helping to prevent the development of lymphedema

Hematoma or Seroma Formation. Hematoma formation (collection of blood inside a cavity) may occur after either mastectomy or breast conservation and usually develops within the first 12 hours after surgery. The nurse assesses for signs and symptoms of hematoma at the surgical site, which may include swelling, tightness, pain, and bruising of the skin. The surgeon should be notified immediately if there is gross swelling or increased bloody output from the drain. Depending on the surgeon's assessment, a compression wrap may be applied to the incision for approximately 12 hours, or the patient may be returned to the operating room so that the incision may be

reopened to identify the source of bleeding. Some hematomas are small, and the body absorbs the blood naturally. The patient may take warm showers (if permitted by the surgeon) or apply warm compresses to help increase the absorption. A hematoma usually resolves in 4 to 5 weeks.

A seroma, a collection of serous fluid, may accumulate under the breast incision after mastectomy or breast conservation or in the axilla. Signs and symptoms may include swelling, heaviness, discomfort, and a sloshing of fluid. Seromas may develop temporarily after the drain is removed or if the drain is in place and becomes obstructed. Seromas rarely pose a threat and may be treated by unclogging the drain or manually aspirating the fluid with a needle and syringe. Large, long-standing seromas that have not been aspirated may lead to infection. Small seromas that are not bothersome to the patient usually resolve on their own.

Infection. Although infection is rare, it is a risk after any surgical procedure. This risk may be higher in patients with conditions such as diabetes, immune disorders, and advanced age, as well as in those with poor hygiene. Patients are taught to monitor for signs and symptoms of infection (redness, warmth around incision, tenderness, foul-smelling drainage, temperature greater than 40°C [100.4°F], chills) and to contact the surgeon or nurse for evaluation. Treatment consists of oral or IV antibiotics (for more severe infections) for 1 or 2 weeks. Cultures are taken of any foul-smelling discharge.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. Patients who undergo breast cancer surgery receive a tremendous amount of information both pre- and postoperatively. It is often difficult for the patient to absorb all of the information, partly because of the emotional distress that often accompanies the diagnosis and treatment. Prior to discharge, the nurse must assess the patient's readiness to assume self-care responsibilities and identify any gaps in knowledge. A review of education provided in written and oral forms, with reinforcement, may be required to ensure that the patient and family are prepared to manage the necessary care at home. The nurse reiterates symptoms that the patient should report, such as infection, seroma, hematoma, or arm swelling. All instruction should be reinforced during follow-up visits of the patients.

Most patients are discharged 1 or 2 days after ALND or mastectomy (possibly later if they have had immediate reconstruction) with surgical drains in place. Initially, the drainage fluid appears bloody, but it gradually changes to a serosanguineous and then a serous fluid over the next several days. The patient is given instructions about drainage management at home (see Chart 58-15). If the patient lives alone and drainage management is difficult, a referral for a home care nurse should be made. The drains are usually removed when the output is less than 30 mL in a 24-hour period (approximately 7 to 10 days). The home care nurse also reviews pain management and incision care.

In general, the patient may shower on the second postoperative day and wash the incision and drain site with soap and water to prevent infection. Some surgeons do not permit showers until 48 hours after drains are removed. If immediate reconstruction has been performed, showering may be contraindicated until the drain is removed. A dry dressing may be applied to the incision each day for 7 days. The patient should realize that sensation may be decreased in the operative area because the nerves were disrupted during surgery, and she should be informed that gentle care is needed to avoid injury. After the incision has completely healed (usually after 4 to 6 weeks), lotions or creams may be applied to the area to increase skin elasticity. The patient can begin to use deodorant on the affected side, although many women note that they no longer perspire as much as before the surgery.

Chart 58-15 HOME CARE CHECKLIST

Patient with a Drainage Device Following Breast Surgery

At the completion of education, the patient and/or caregiver will be able to:

- Name the procedure that was performed and identify changes in anatomic structure or function as well as changes in ADLs, IADLs, roles, relationships, and spirituality.
- Identify interventions and strategies (e.g., prosthesis) used in adapting to any permanent changes in structure or function.
- Describe ongoing postoperative therapeutic regimen, including diet and activities to perform (e.g., when to shower, arm exercises) and to limit or avoid (e.g., lifting weights, driving a car, contact sports).
- State the name, dose, side effects, frequency, and schedule for all medications.
- Describe approaches to controlling pain (e.g., take analgesics as prescribed; use nonpharmacologic interventions).
- State how to obtain medical supplies and carry out dressing changes, wound care, and other prescribed regimens.
  - Care for the drain site and incision as per surgeon's recommendation.
  - Demonstrate how to empty and measure fluid from the drainage device.
  - Demonstrate how to milk clots through the tubing of the drainage device.
  - Identify when the drain is ready for removal (usually when draining <30 mL for a 24-hour period).
- Describe signs and symptoms of complications.
  - State observations that require contacting the physician or nurse (e.g., sudden change in color of drainage, sudden cessation of drainage, signs or symptoms of an infection).
- Relate how to reach primary provider with questions or complications.
- State time and date of follow-up appointments, therapy, and testing.
- Identify sources of support (e.g., friends, relatives, cancer support groups, caregiver support).
- Identify the need for health promotion, disease prevention, and screening activities (e.g. gynecologic examination, mammogram).

ADL, activities of daily living; IADL, independent activities of daily living.

After ALND, patients are taught arm exercises on the affected side to restore range of motion (see Chart 58-16). After SLNB, patients may also benefit from these exercises, although they are less likely to have decreased range of motion than those who have undergone ALND. Range-of-motion exercises are initiated on the second postoperative day; however, instruction often occurs on the first postoperative day. The goals of the exercise regimen are to increase circulation and muscle strength, prevent joint stiffness and contractures, and restore full range of motion. The patient is instructed to perform range-of-motion exercises at home three times a day for 20 minutes at a time until full range of motion is restored (generally 4 to 6 weeks). Most patients find that after the drain is removed, range of motion returns quickly if they have adhered to their exercise program.

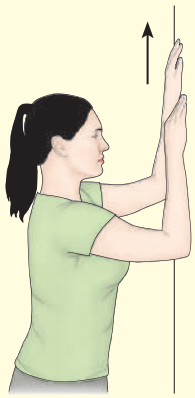
If the patient is having any discomfort, taking an analgesic agent 30 minutes before beginning the exercises can be helpful. Taking a warm shower before exercising can also loosen stiff

Chart 58-16 PATIENT EDUCATION

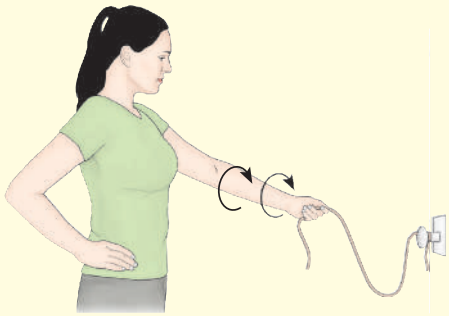
Exercise After Breast Surgery

The nurse instructs the patient to perform the following exercises:

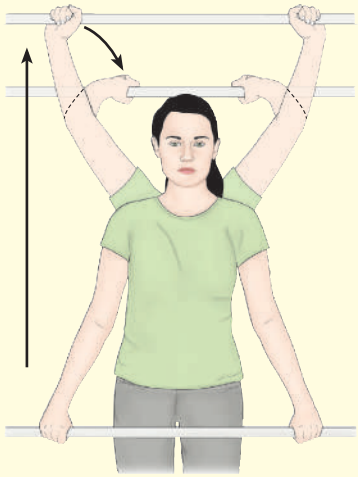
1. *Wall handclimbing.* Stand facing the wall with feet apart and toes as close to the wall as possible. With elbows slightly bent, place the palms of the hand on the wall at shoulder level. By flexing the fingers, work the hands up the wall until arms are fully extended. Then reverse the process, working the hands down to the starting point.



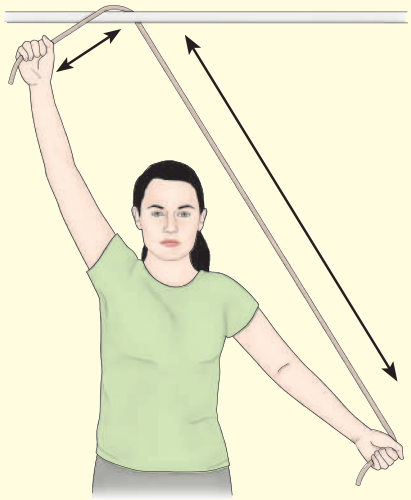
2. *Rope turning.* Tie a light rope to a doorknob. Stand facing the door. Take the free end of the rope in the hand on the side of surgery. Place the other hand on the hip. With the rope-holding arm extended and held away from the body (nearly parallel with the floor), turn the rope, making as wide swings as possible. Begin slowly at first; speed up later.



3. *Rod or broomstick lifting.* Grasp a rod with both hands, held about 2 feet apart. Keeping the arms straight, raise the rod over the head. Bend elbows to lower the rod behind the head. Reverse maneuver, raising the rod above the head, then return to the starting position.



4. *Pulley tugging.* Toss a light rope over a shower curtain rod or doorway curtain rod. Stand as close to the rope as possible. Grasp an end in each hand. Extend the arms straight and away from the body. Pull the left arm up by tugging down with the right arm, then the right arm up and the left down in a see-sawing motion.



muscles and provide comfort. When exercising, the patient is encouraged to use the muscles in both arms and to maintain proper posture. Specific exercises may need to be prescribed and introduced gradually if the patient has had skin grafts; has a tense, tight surgical incision; or has had immediate reconstruction. Self-care activities, such as brushing the teeth, washing the face, and brushing the hair, are physically and emotionally therapeutic because they aid in restoring arm function and provide a sense of normalcy for the patient.

The patient is instructed about postoperative activity limitation. In general, heavy lifting (more than 2.3 to 5.4 kg is avoided for about 4 to 6 weeks, although normal household and work-related activities are promoted to maintain muscle tone. Brisk walking, the use of stationary bikes and stepping machines, and stretching exercises may begin as soon as the patient feels comfortable. Once the drain is removed, the patient may begin to drive if she has full arm range of motion and is no longer taking opioid analgesic agents. General guidelines for activity focus on the gradual introduction of previous activities (e.g., bowling, weight training) once fully healed.

Continuing and Transitional Care. Patients who have difficulty managing their postoperative care at home may benefit from a referral for home health, transitional, or community-based care. The nurse making a home visit assesses the patient's incision and surgical drain(s), adequacy of pain management, adherence to the exercise plan, and overall physical and psychological functioning. In addition, the home care nurse reinforces

previous education and communicates important physiologic findings and psychosocial issues to the patient's primary provider, nurse, or surgeon.

The frequency of follow-up visits after surgery may vary but generally should occur every 3 to 6 months for the first several years. The patient may alternate visits with the surgeon, medical oncologist, or radiation oncologist, depending on the treatment regimen. The ambulatory care nurse can also be a great source of education for the patient and family and should encourage them to telephone if they have any questions or concerns. It is common for people to ignore routine health care when a major health issue arises, so women who have been treated for breast cancer should be reminded of the importance of participating in routine health screening.

Evaluation

Expected preoperative patient outcomes may include:

1. Exhibits knowledge about diagnosis and surgical treatment options
   a. Asks relevant questions about diagnosis and available surgical treatments
   b. States rationale for surgery
   c. Describes advantages and disadvantages of treatment options
2. Verbalizes willingness to deal with anxiety and fears related to the diagnosis and the effects of surgery on self-image and sexual functioning
3. Demonstrates ability to cope with diagnosis and treatment
   a. Verbalizes feelings appropriately and recognizes normalcy of mood lability
   b. Proceeds with treatment in timely fashion
   c. Discusses impact of diagnosis and treatment on family and work
4. Makes decisions regarding treatment options in timely fashion

Expected postoperative patient outcomes may include:

1. Reports that pain has decreased and states pain and discomfort management strategies are effective
2. Identifies postoperative sensations and recognizes that they are a normal part of healing
3. Exhibits clean, dry, and intact surgical incisions without signs of inflammation or infection
4. Lists the signs and symptoms of infection to be reported to the nurse or surgeon
5. Verbalizes feelings regarding change in body image
6. Discusses meaning of the diagnosis, surgical treatment, and fears appropriately
7. Participates actively in self-care measures
   a. Performs exercises as prescribed
   b. Participates in self-care measures as prescribed
8. Discusses issues of sexuality and resumption of sexual relations
9. Demonstrates knowledge of post discharge recommendations and restrictions
   a. Describes follow-up care and activities
   b. Demonstrates appropriate care of incisions and drainage system
   c. Demonstrates arm exercises, and describes exercise regimen and activity limitations during postoperative period
   d. Describes care of affected arm and hand, and lists indications to contact the surgeon or nurse
10. Experiences no complications
    a. Identifies signs and symptoms of reportable complications (e.g., fever, redness, heat, pain, edema)
    b. Explains how to contact appropriate providers in case of complications

Radiation Therapy

Radiation therapy is used to decrease the chance of a local recurrence in the breast by eradicating residual microscopic cancer cells. Breast conservation treatment followed by radiation therapy for stages I and II breast cancer results in a survival rate equal to that of a modified radical mastectomy (NCCN, 2015). If radiation therapy, which is part of breast conservation treatment (see Chart 58-17), is contraindicated, a mastectomy would then be indicated.

External-beam radiation (the most common type) typically begins about 6 weeks after breast conservation to allow the surgical site to heal. If systemic chemotherapy is indicated, radiation therapy usually begins after its completion. Before radiation begins, the patient undergoes a planning session called a *simulation,* in which the anatomic areas to be treated are mapped out and then identified with small permanent ink markings. External-beam radiation, which delivers high-energy photons from a linear accelerator, is given to the entire breast region (whole breast radiation). Each treatment lasts only a few minutes and is generally given 5 days a week for 5 to 6 weeks. After completion of radiation to the entire breast, many patients receive a "boost"—a dose of radiation to the lumpectomy site where the cancer cells were located. The boost consists of the same dose of radiation but is less penetrating and directed to a smaller area. The treatments are not painful.

Because most breast cancer recurrences appear at or near the lumpectomy site, the need for whole breast radiation has been questioned. Partial breast radiation (radiation to the lumpectomy site alone) continues be evaluated at some institutions in patients who have been carefully selected. One approach is brachytherapy, in which radiation is delivered by an internal device that is placed close to the tumor within the breast. This technique can lead to an improved quality of life because the treatments are given over 4 to 5 days instead of 5 to 6 weeks. After mastectomy, postoperative radiation may be indicated for women at high risk for cancer recurrence (i.e.,

Chart 58-17

Contraindications to Breast Conservation Treatment

Note: Breast-conservation treatment includes both surgery and radiation.

Absolute Contraindications

- First or second trimester of pregnancy
- Presence of multicentric disease in the breast
- Prior radiation to the breast or chest region

Relative Contraindications

- History of collagen vascular disease
- Large tumor-to-breast ratio
- Tumor beneath nipple

Adapted from Harris, J., & Morrow, M. (2014). Breast-conserving therapy. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

chest wall involvement, four or more positive lymph nodes, tumors larger than 5 cm, positive surgical margins).

Side Effects

In general, radiation therapy is well tolerated. Acute side effects consist of mild to moderate erythema, breast edema, and fatigue. Occasionally, skin breakdown may occur in the inframammary fold or near the axilla toward the end of treatment. Fatigue can be depressing, as can the frequent trips to the radiation oncology unit for treatment. The patient needs to be reassured that the fatigue is normal and not a sign of recurrence. Side effects usually resolve within a few weeks to a few months after treatment is completed. Rare long-term effects of radiation therapy include pneumonitis, rib fracture, heart disease, breast fibrosis or necrosis (Harris & Morrow, 2014).

Nursing Management

Nurses play a significant role in supporting patients throughout their treatment with radiation therapy.

Self-care instructions for patients receiving radiation are provided to assist in the maintenance of skin integrity during the treatments and for several weeks after completion. They pertain only to the area being treated and not to the rest of the body. Instructions include:

- Use mild soap with minimal rubbing.
- Avoid perfumed soaps or deodorants.
- Use hydrophilic lotions (Lubriderm, Eucerin, Aquaphor) for dryness.
- Use a nondrying, antipruritic soap (Aveeno) if pruritus occurs.
- Avoid tight clothes, underwire bras, excessive temperatures, and ultraviolet light.

Follow-up care includes educating the patient to minimize sun exposure to the treated area (i.e., using sunblock with sun protection factor [SPF] of 15 or higher) and reassuring the patient that short-term minor twinges and pain in the breast are normal after radiation treatment.

Systemic Treatments

Chemotherapy

Adjuvant chemotherapy involves the use of anticancer agents in addition to other treatments (i.e., surgery, radiation) to delay or prevent a recurrence of breast cancer. It is recommended for patients who have positive lymph nodes or who have invasive tumors greater than 1 cm in size, regardless of nodal status. It is considered in patients with tumors that are 0.6 to 1 cm, are moderately to poorly differentiated, or have unfavorable features (NCCN, 2015). Table 58-18 outlines general indications for adjuvant chemotherapy. A survival benefit has been shown in both women who are pre- and postmenopausal and who have received chemotherapy, although data are limited in women older than 70 years. Chemotherapy is most commonly initiated after breast surgery and before radiation. Patients who delay initiation of chemotherapy beyond 90 days postsurgery have an increased risk of adverse outcomes (Chavez-McGregor, Clarke, Lichtensztajn, et al., 2016). Nurses encourage and assist in facilitating timely treatment to optimize outcomes.

Chemotherapy regimens for breast cancer combine several agents (polychemotherapy), generally given over a period of 3 to 6 months. Decisions regarding the optimal regimen are based on a variety of factors, including tumor characteristics

TABLE 58-18 General Indications for Adjuvant Chemotherapy for Breast Cancer

Nodal Status, Tumor Size	Adjuvant Chemotherapy
Node negative, ≤0.5 cm	None
Node negative 0.6–1 cm (well differentiated)	None
Node negative, 0.6–1 cm (moderately or poorly differentiated and/or unfavorable features)	Consider chemotherapy
Node negative, >1 cm	Chemotherapy
Node positive, any tumor size	Chemotherapy

- In addition to chemotherapy, patients with HER-2/neu-positive tumors will receive trastuzumab if they have node-positive disease; or node-negative disease with a tumor >1 cm. Trastuzumab is a monoclonal antibody that targets and inactivates the HER-2/neu protein. HER-2/neu is overproduced in 25–30% of tumors and is associated with rapid growth and poor prognosis.
- Following chemotherapy, patients with hormone receptor positive (ER+/PR+) tumors will receive hormonal therapy (tamoxifen or aromatase inhibitor) if they have either node-positive disease; node-negative disease with a tumor >1 cm; or node-negative disease with a tumor 0.6–1 cm and moderately or poorly differentiated and/or unfavorable features.

Note: These are only general guidelines. Recommendations may vary depending on factors such as prognostic variables, patient age, and comorbid conditions.

Adapted from National Comprehensive Cancer Network (NCCN). (2015). Clinical practice guidelines: Breast. Retrieved on 3/7/2016 at: www.nccn.org/professionals/physician_gls/PDF/infections.pdf

(i.e., tumor size, lymph node status, hormone receptor status, HER-2/neu status) and the patient's age, physical status, and existing comorbid conditions. A regimen that includes cyclophosphamide (Cytoxan), methotrexate (Trexall), and fluorouracil (Fluoroplex) (collectively referred to as CMF) has been the most widely used adjuvant therapy. It is usually well tolerated and may be considered for patients with a low risk of recurrence. CMF also may be considered for use in patients who have a high risk of cardiac toxicity or who have other limiting comorbidities. Anthracycline-based regimens (e.g., doxorubicin [Adriamycin], epirubicin [Ellence]) have shown longer survival in patients. However, the benefit relative to CMF is modest and is accompanied by increased toxicity (Meneses & Walker, 2014). Selection of patients most likely to benefit from anthracycline therapy would allow better use of current cytotoxic agents and reduce the risk of patients receiving toxicity with little or no effect. Identifying biomarkers that can accurately predict benefit from anthracyclines will also highlight key resistance/susceptibility pathways that can then be exploited clinically to further increase efficacy (Meneses & Walker, 2014). Cyclophosphamide, doxorubicin, and fluorouracil (CAF) and doxorubicin and cyclophosphamide (AC) are examples of combination regimens often given to patients who are at high risk.

The taxanes (paclitaxel [Taxol], docetaxel [Taxotere]) are generally incorporated into treatment regimens for patients with larger, node-negative cancers and for those with positive axillary lymph nodes. The addition of four cycles of paclitaxel after a standard course of AC (regimen known as ACT) has been found to increase the disease-free period and improve overall survival in patients with operable breast cancer and positive lymph nodes (Meneses & Walker, 2014).

Much attention has been focused on dose-dense chemotherapy, which is the administration of chemotherapeutic agents at standard doses with shorter time intervals between each cycle

of treatment. A systematic review and meta-analysis of existing data from randomized controlled trials that compared dose-dense chemotherapy with a standard chemotherapy schedule in women with nonmetastatic breast cancer demonstrated that dose-dense chemotherapy results in better overall and disease-free survival, particularly in women with hormone receptor–negative breast cancer (Bonilla, Ben-Aharon, Vidal, et al., 2010). However, additional data from randomized controlled trials are needed before dose-dense chemotherapy can be considered the standard of care (Bardia & Baselga, 2014).

Side Effects

Many of the side effects of adjuvant chemotherapy can be managed well, allowing patients to maintain their daily routines and work schedules. In large part, this is the a result of the meticulous educational and psychological preparation provided to patients and their families by oncology nurses, oncologists, social workers, and other members of the health care team. In addition, strides have been made in the effectiveness of antiemetic agents used to alleviate nausea and vomiting and the use of hematopoietic growth factors to treat neutropenia and anemia.

Common physical side effects of chemotherapy for breast cancer may include nausea, vomiting, bone marrow suppression, taste changes, alopecia (hair loss), mucositis, neuropathy, skin changes, and fatigue. A weight gain of more than 4.5 kg occurs in about half of all patients; the cause is unknown. Women who are premenopausal may also experience temporary or permanent amenorrhea.

Specific side effects vary with the type of chemotherapeutic agent used. In general, CMF and the taxanes are better tolerated than the anthracyclines. However, the taxanes can cause peripheral neuropathy, arthralgias, and myalgias, particularly at high doses. During taxane administration, hypersensitivity reactions may occur; therefore, the patient must be premedicated. Alopecia is also common. The side effects of the anthracyclines may be severe and include cardiotoxicity in addition to nausea and vomiting, bone marrow suppression, and alopecia. Their vesicant properties can lead to tissue necrosis if infiltration of the medication infusion occurs.

Nursing Management

Nurses play an important role in helping patients manage the physical and psychosocial sequelae of chemotherapy. (Earlier part of this chapter provides an in-depth discussion of side effect management.) Instructing the patient about the use of antiemetic agents and reviewing the optimal dosage schedule can help minimize nausea and vomiting. The different classes of antiemetic agents include serotonin (5-HT-3) receptor antagonists (palonosetron [Aloxi], granisetron [Kytril], ondansetron [Zofran]); neurokinin-1 receptor antagonists (aprepitant [Emend]); dopamine receptor antagonists (prochlorperazine [Compazine], metoclopramide [Reglan]); benzodiazepines (lorazepam [Ativan]); and corticosteroids (dexamethasone [Decadron]). Measures to ease the symptoms of mucositis may include rinsing with normal saline or sodium bicarbonate solution, avoiding hot and spicy foods, and using a soft toothbrush.

Some patients may require hematopoietic growth factors to minimize the effects of chemotherapy-induced neutropenia and anemia. Granulocyte colony-stimulating factors boost the white blood cell count, helping to reduce the incidence of neutropenic fever and infection. The short-acting form, filgrastim (Neupogen), is injected subcutaneously or IV for 7 to 10 days after chemotherapy administration. The long-acting form, pegfilgrastim (Neulasta), is injected once, no earlier than 24 hours after chemotherapy (Comerford, 2015). Erythropoietin growth factor increases the production of red blood cells, thus decreasing the symptoms of anemia. The short-acting form, epoetin alfa (Epogen) is usually given weekly. The long-acting form, darbepoetin alfa (Aranesp), can be given every 2 to 3 weeks. The nurse instructs the patient and family on proper injection technique of hematopoietic growth factors and about symptoms that require follow-up with a primary provider (see Chart 58-18).

Chart 58-18 HOME CARE CHECKLIST

Self-Administration of Hematopoietic Growth Factors

At the completion of education, the patient and/or caregiver will be able to:

- State the impact of treatment on physiologic functioning, ADLs, IADLs, roles, relationships, and spirituality.
- Identify the benefits and expected outcome of hematopoietic growth factors.
- Locate list of names and telephone numbers of resource personnel involved in care (e.g., health care professionals, home care nurse, hematopoietic growth factor and supply vendor).
- Identify the equipment necessary for self-injection and how to obtain hematopoietic growth factor and supplies.
- Demonstrate how to give an injection properly, including:
  - How to draw up the solution in a syringe if indicated. (*Note:* Darbepoetin and pegfilgrastim come in prefilled syringes).
  - Identify appropriate body sites for self-injection.
  - Demonstrate correct disposal of sharps.
  - Describe proper storage of supplies.
- State what types of lifestyle and environmental changes are needed (if any) to maintain a clean home environment and prevent infection.
- State the name, dose, side effects, frequency, and schedule for all medications.
- List complications of medications/therapeutic regimen necessitating a call to the nurse or primary provider. (e.g., excessive pain, fever).
- List complications of medications/therapeutic regimen necessitating a visit to the emergency department.
- Explain treatment plan and importance of follow-up care to all health care providers.
  - State time and date of follow-up appointments, therapy, and testing.
- Identify community resources for peer and caregiver/family support:
  - Identify sources of support (e.g., friends, relatives, faith community).
  - Identify phone numbers of support groups for people with cancer and their caregivers/families.
  - State meeting locations and times.
- Identify the need for health promotion, disease prevention, and screening activities.

ADL, activities of daily living; IADL, independent activities of daily living.

To prevent some of the emotional trauma associated with alopecia, it often helps to have a patient obtain a wig before hair loss begins to occur. The nurse may provide a list of wig suppliers in the patient's geographic region. Familiarity with creative ways to use scarves and turbans may also help minimize the patient's distress. The patient needs reassurance that new hair will grow back when treatment is completed, although the color and texture may be different. The ACS offers the Look Good Feel Better program, which provides useful tips for applying cosmetics during the period a patient is receiving chemotherapy (see Resources sections).

Chemotherapy may negatively affect the patient's self-esteem, sexuality, and sense of well-being. This, combined with the stress of a potentially life-threatening disease, can be acute. Providing support and promoting open communication are important aspects of nursing care. Referring the patient to the dietitian, social worker, psychiatrist, or spiritual advisor can provide additional support. Numerous community support and advocacy groups are available for patients and their families. Complementary therapies, such as guided imagery, meditation, and relaxation exercises, can also be used in conjunction with conventional treatments.

Hormonal Therapy

The use of adjuvant hormonal therapy, with or without the addition of chemotherapy, is considered in women who have hormone receptor–positive tumors. Its use can be determined by the results of an estrogen and progesterone receptor assay (a test to determine whether the breast tumor is nourished by hormones). About two thirds of breast cancers depend on estrogen for growth and express a nuclear receptor that binds to the estrogen; thus, they are estrogen receptor positive (ER+). Similarly, tumors that express the progesterone receptor are progesterone receptor positive (PR+). Hormonal therapy involves the use of synthetic hormones or other medications that compete with estrogen by binding to the receptor sites (SERMs), or the use of aromatase inhibitors, which block estrogen production by the adrenal glands. In general, tumors that are ER+/PR+ have the greatest likelihood of responding to hormonal therapy and have a more favorable prognosis than those that are ER–/PR–. Women who are pre- and perimenopausal are more likely to have non–hormone-dependent lesions, whereas women who are postmenopausal are more likely to have hormone-dependent lesions.

Traditionally, the SERM tamoxifen has been the main hormonal agent used in treatment of pre- and postmenopausal breast cancer and remains the mainstay in women who are premenopausal. As an SERM, tamoxifen has estrogen antagonistic (estrogen-blocking) and agonistic (estrogenlike) effects on certain tissues. Its antagonistic effects in the breast prevent estrogen from binding to the receptor sites, thus preventing tumor growth. Tamoxifen has positive agonistic effects on blood lipid profiles and bone mineral density in women who are postmenopausal. It also has agonistic effects on endometrial tissue and blood coagulation processes, leading to an increased incidence of endometrial cancer and thromboembolic events (e.g., deep vein thrombosis, superficial phlebitis, pulmonary embolism). Nevertheless, the benefits in most women with breast cancer outweigh the risks.

The aromatase inhibitors anastrozole (Arimidex), letrozole (Femara), and exemestane (Aromasin) are important components in the hormonal management of women who are postmenopausal. Most of the circulating estrogens in women who are postmenopausal are derived from the conversion of the adrenal androgen androstenedione to estrone and the conversion of testosterone to estradiol. Aromatase inhibitors work by blocking the enzyme aromatase from performing the conversion, thereby decreasing the level of circulating estrogen in peripheral tissues. Clinical trials have demonstrated that the aromatase inhibitors are superior to tamoxifen in terms of overall response rate and clinical benefit and that inhibitors appear to be effective and feasible compared with tamoxifen as first-line hormonal therapy in women who are postmenopausal with advanced breast cancer (Rimawi & Osborne, 2014). These data ensure that aromatase inhibitors will play an increasingly central role in the long-term management of breast cancer. Trials are ongoing to determine the optimal treatment regimen and the timing of the treatment. Table 58-19 outlines the adverse effects of adjuvant hormonal therapy. Chart 58-19 outlines appropriate patient education to manage the adverse effects.

Targeted Therapy

An exciting area of research in the systemic treatment of breast cancer involves the use of targeted therapies. Trastuzumab (Herceptin) is a monoclonal antibody that binds specifically to the HER-2/neu protein. This protein, which regulates cell growth, is present in small amounts on the surface of normal breast cells and in most breast cancers. Approximately 25% to 30% of tumors overexpress (overproduce) the HER-2/neu protein and are associated with rapid growth and poor prognosis. Trastuzumab targets and inactivates the HER-2/neu protein, thus slowing tumor growth.

Unlike chemotherapy, trastuzumab spares the normal cells and has limited adverse reactions, which may include fever, chills, nausea, vomiting, diarrhea, and headache. However,

TABLE 58-19 Adverse Reactions Associated with Adjuvant Hormonal Therapy used to Treat Breast Cancer

Therapeutic Agent	Adverse Reactions/Side Effects
Selective Estrogen Receptor Modulator	
Tamoxifen (Soltamox)	Hot flashes, vaginal dryness/discharge/bleeding, irregular menses, nausea, mood disturbances, rashes; increased risk for endometrial cancer; increased risk for thromboembolic events (deep vein thrombosis, pulmonary embolism, superficial phlebitis)
Aromatase Inhibitors	
Anastrozole (Arimidex) Letrozole (Femara) Exemestane (Aromasin)	Musculoskeletal symptoms (arthritis, arthralgia, myalgia), increased risk of osteoporosis/fractures, nausea/vomiting, hot flashes, fatigue, mood disturbances, rashes

Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Chart 58-19 PATIENT EDUCATION

Managing Side Effects of Adjuvant Hormonal Therapy in Breast Cancer

The nurse instructs the patient in strategies to manage the following side effects:

Hot Flashes

- Wear breathable, layered clothing.
- Avoid caffeine and spicy foods.
- Perform breathing exercises (paced respirations).
- Consider medications (vitamin E, antidepressants) or acupuncture.

Vaginal Dryness

- Use vaginal moisturizers for everyday dryness (e.g., Replens, vitamin E suppository).
- Apply vaginal lubrication during intercourse (e.g., Astroglide, K-Y Jelly).

Nausea and Vomiting

- Consume a bland diet.
- Try to take medication in the evening.

Musculoskeletal Symptoms

- Take nonsteroidal analgesic agents as recommended.
- Take warm baths.

Risk of Endometrial Cancer

- Report any irregular bleeding to a gynecologist for evaluation.

Risk for Thromboembolic Events

- Report any redness, swelling, or tenderness in the lower extremities, or any unexplained shortness of breath.

Risk for Osteoporosis or Fractures

- Undergo a baseline bone density scan.
- Perform regular weight-bearing exercises.
- Take calcium supplements with vitamin D.
- Take bisphosphonates (e.g., alendronate) or calcitonin as prescribed.

when trastuzumab is given to patients who have previously been treated with an anthracycline, the risk of cardiac toxicity is increased. The medication has been shown to improve survival rates in women with HER-2/neu–positive metastatic breast cancer and is now regarded as standard therapy. It may be given as a single agent or in combination with chemotherapy. More recently, trastuzumab has been shown to be effective in treating early-stage breast cancer that is HER-2/neu positive. Assessing the benefits and risks of trastuzumab is complex, and medical oncologists often use a variety of aids in their decision making (Kimmick, Hughes, & Muss, 2014).

Treatment of Recurrent and Metastatic Breast Cancer

Despite the advances made in the treatment of breast cancer, it may recur locally (on the chest wall or in the conserved breast), regionally (in the remaining lymph nodes), or systemically (in distant organs). In metastatic disease, the bone, usually the hips, spine, ribs, skull, or pelvis, is the most common site of spread. Other sites of metastasis include the lungs, liver, pleura, and brain.

The overall prognosis and optimal treatment are determined by a variety of factors such as the site and extent of recurrence, the time to recurrence from the original diagnosis, history of prior treatments, the patient's performance status, and any existing comorbid conditions. Patients with bone metastases generally have a longer overall survival compared with metastases in visceral organs.

Local recurrence in the absence of systemic disease is treated aggressively with surgery, radiation, and hormonal therapy. Chemotherapy may also be used for tumors that are not hormonally sensitive. Local recurrence may be an indicator that systemic disease will develop in the future, particularly if it occurs within 2 years of the original diagnosis (NCCN, 2015).

Metastatic breast cancer involves control of the disease rather than cure (NCCN, 2015). Treatment includes hormonal therapy, chemotherapy, and targeted therapy. Surgery or radiation may be indicated in select situations. Women who are premenopausal and who have hormonally dependent tumors may eliminate the production of estrogen by the ovaries through oophorectomy (removal of the ovaries) or suppression of estrogen production by medications such as leuprolide (Lupron) or goserelin (Zoladex).

Patients with advanced breast cancer are monitored closely for signs of disease progression. Baseline studies are obtained at the time of recurrence. These may include complete blood count; comprehensive metabolic panel; tumor markers (i.e., carcinoembryonic antigen, cancer antigen 15-3); bone scan; CT of the chest, abdomen, and pelvis; and MRI of symptomatic areas. Additional x-rays may be performed to evaluate areas of pain or abnormal areas seen on bone scan (e.g., long bones, pelvis). These studies are repeated at regular intervals to assess for effectiveness of treatment and to monitor progression of disease.

Nursing Management

Nurses play an important role in not only educating patients and managing their symptoms but also in providing emotional support. Many patients find that recurrence of the disease is more distressing than the initial cancer diagnosis. They not only have to contend with another round of treatments but are also faced with a greater uncertainty about their future and long-term survival. The nurse can help the patient identify coping strategies and set priorities to optimize quality of life. Family members and significant others should be included in the treatment plan and follow-up care. Referrals to support groups, as well as psychiatry or psychiatric clinical nurse specialist, social work, and complementary medicine programs (e.g., guided imagery, meditation, yoga), should be made as indicated.

Nurses can also be instrumental in providing palliative care, if indicated. The highest priorities include alleviating pain and providing comfort measures. A frank discussion with the patient and family regarding their preferences for end-of-life care should occur before the need arises to ensure a smooth transition without disruption of care. Referrals to hospice and home health care should be initiated as necessary (see Chapter 59).

Reconstructive Procedures after Mastectomy

Breast reconstruction can provide a significant psychological benefit for women who are already struggling with the

emotional distress of losing a breast. A consultation with a plastic surgeon can help the patient understand procedures for which she is a candidate and the pros and cons of each. Factors to consider include body size and shape, comorbid conditions (e.g., hypertension, diabetes, obesity), personal habits such as smoking, and patient preference. The patient must be informed that although breast reconstruction can provide a good cosmetic result, it will never precisely duplicate the natural breast. Realistic preparation can help the patient avoid unrealistic expectations. Once reconstruction is complete, the opposite breast may require augmentation, reduction, or mastopexy to achieve symmetry on both sides. The patient must also be informed that breast reconstruction neither will interfere with breast cancer treatments nor affect the risk of cancer recurrence. Reconstruction is considered an integral component in the surgical treatment of breast cancer and is usually covered by insurance companies.

Many women elect immediate reconstruction at the time of the mastectomy operation. This can be beneficial in that it saves the woman from undergoing general anesthesia a second time and saves the cost and stress of future hospitalizations. However, it does increase the length of the surgical procedure. Delayed reconstruction is preferable in women who are having a difficult time deciding on the type of reconstruction that they desire. It may also be preferable in patients with advanced disease such as inflammatory breast cancer, where the breast cancer treatments should begin without delay. Any delays in healing after immediate reconstruction may interfere with the initiation of treatment.

Tissue Expander Followed by Permanent Implant

Breast reconstruction using a tissue expander followed by a permanent implant is the simplest and most common method used today (see Fig. 58-15). To accommodate an implant, the skin remaining after a mastectomy and the underlying muscle must gradually be stretched by a process called *tissue expansion.* The surgeon places a tissue expander (a balloonlike device) through the mastectomy incision underneath the pectoralis muscle. A small amount of saline is injected through a metal port intraoperatively to partially inflate the expander. Then, for about 6 to 8 weeks, at weekly intervals, the patient receives additional saline injections through the port until the expander is fully inflated. It remains fully expanded for about 6 weeks to allow the skin to loosen. The expander is then exchanged for a permanent implant. This is usually performed as an outpatient surgical procedure.

Advantages of the expansion procedure are a shorter operating time and a shorter recuperation period than for autologous reconstruction (see the Tissue Transfer Procedures section). A disadvantage is a tendency for the implant to feel firm and round, with little natural ptosis (sag). Women with a small to medium opposite breast with little ptosis are good candidates for this procedure. Women who have had radiation or who have connective tissue disease are not good candidates because of the decreased elasticity of the skin.

Nursing Alert: The patient must be cautioned not to have an MRI while the tissue expander is in place because the port contains metal. This is not an issue once the permanent implant is in place because it does not contain any metal.

The patient should be informed that for the rest of her life she should not engage in any exercises that will develop the pectoralis muscle, because this can result in distortion of the reconstructed breast.

Tissue Transfer Procedures

Autologous reconstruction is the use of the patient's own tissue to create a breast mound. A flap of skin, fat, and muscle with its attached blood supply is rotated to the mastectomy site to create a mound that simulates the breast. Donor sites may include the transverse rectus abdominal myocutaneous (TRAM) flap (abdominal muscle) (see Fig. 58-16), gluteal flap (buttock muscle), or the latissimus dorsi flap (back muscle) (see Fig. 58-17). The results more closely resemble a real breast because the skin and fat from the donor sites are similar in consistency to a natural breast. These procedures avoid the use of synthetic material. However, they involve longer recuperation than a tissue expander procedure. The risk of potential complications (e.g., infection, bleeding, flap necrosis) is also

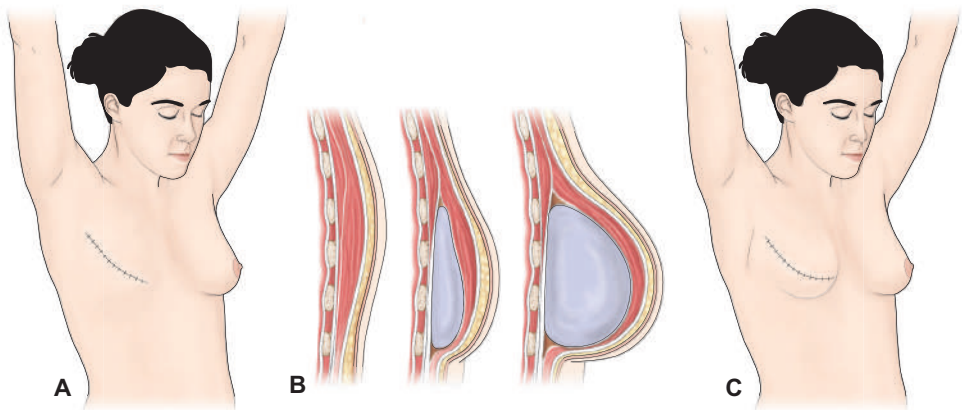


Figure 58-15 • Breast reconstruction with tissue expander. **A.** Mastectomy incision line prior to tissue expansion. **B.** The expander is placed under the pectoralis muscle and is gradually filled with saline solution through a port to stretch the skin enough to accept a permanent implant. **C.** The breast mound is restored. Although permanent, scars will fade with time. The nipple and areola are reconstructed later. Adapted from American Society of Plastic Surgeons.

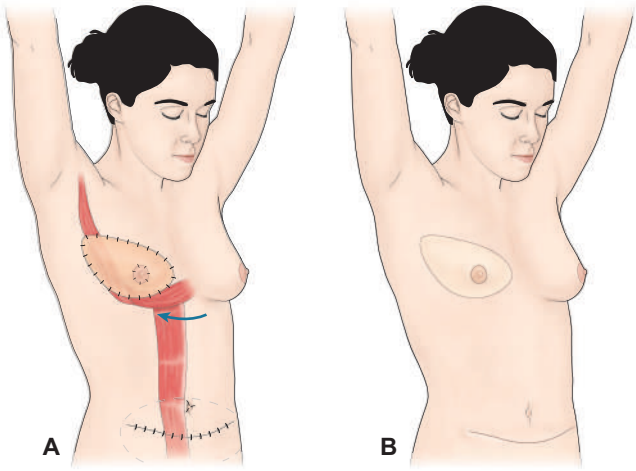


Figure 58-16 • Breast reconstruction: transverse rectus abdominal myocutaneous flap. **A.** A breast mound is created by tunneling abdominal skin, fat, and muscle to the mastectomy site. **B.** Final location of scars. Adapted from American Society of Plastic Surgeons.

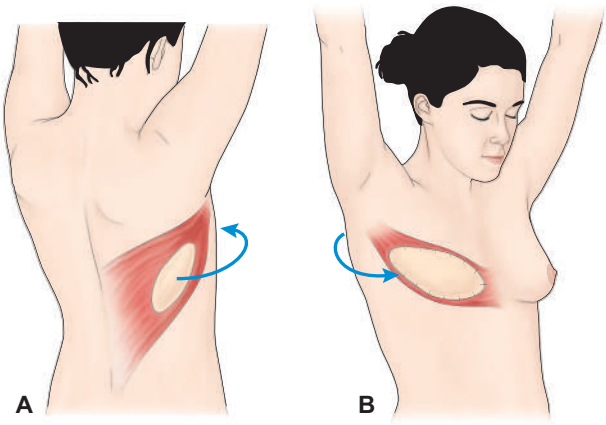


Figure 58-17 • Breast reconstruction: latissimus dorsi flap. **A.** The latissimus muscle with an ellipse of skin is rotated from the back to the mastectomy site. **B.** Because the flap is usually not bulky enough to provide an adequate breast mound, an implant is often also required. Adapted from American Society of Plastic Surgeons.

greater. Therefore, patients must be in relatively good health, and those with medical conditions (e.g., atherosclerosis, pulmonary disease, heart failure) that affect circulation or compromise oxygen delivery are not good candidates. Other candidates who are poor risks include those with poorly controlled diabetes or morbid obesity and those who smoke.

The TRAM flap is the most commonly performed tissue transfer procedure. A free TRAM procedure may also be performed; in this case, the skin, fat, muscle, and blood supply are completely detached from the body and then transplanted to the mastectomy site using microvascular surgery (the use of a microscope to reconnect the vessels). Postoperatively, patients who have undergone TRAM procedures often face a lengthy recovery (often 6 to 8 weeks) and have incisions both at the mastectomy site and at the donor site in the abdomen. Other free flap procedures include deep inferior epigastric perforator flap (DIEP) and superficial inferior epigastric artery flap (SIEA) depending on whether the superior gluteal artery perforator or the inferior one is utilized. Free flaps involve microsurgery for blood vessel transfer.

Deep breathing and leg exercises are essential because the patient is more limited in her activity and is at greater risk for respiratory complications and deep vein thrombosis. Measures to help the patient reduce tension on the abdominal incision during the first postoperative week include elevating the head of the bed 45 degrees and flexing the patient's knees.

Once the patient is able to ambulate, she can protect the surgical incision by splinting it and will gradually achieve a more upright position. The patient is instructed to avoid high-impact activities and lifting (more than 2.3 to 4.5 kg for 6 to 8 weeks after surgery) to prevent stress on the incision.

Nipple–Areola Reconstruction

After the breast mound has been created and the site has healed, some women choose to have nipple–areola reconstruction. This is a minor surgical procedure carried out either in the physician's office or at an outpatient surgical facility. The most common method of creating a nipple is with the use of local flaps (skin and fat from the center of the new breast mound), which are wrapped around each other to create a projecting nipple. The areola is created using a skin graft. The most common donor site is the upper inner thigh, because this skin has darker pigmentation than the skin on the reconstructed breast. After the nipple graft has healed, micropigmentation (tattooing) can be performed to achieve a more natural color. The surgeon can usually match the reconstructed nipple–areola complex with that of the contralateral breast for an acceptable cosmetic result.

Prosthetics

Not all patients desire or are candidates for reconstructive surgery. A breast prosthesis—an external form that simulates the breast—is another option. Prostheses are available in different shapes, sizes, colors, and materials, although they are most often made of silicone. They can be placed inside a pocket in a bra or can adhere directly to the chest wall. The nurse can provide the patient with the names of shops where she can be fitted for a prosthesis, or the patient can call the Reach to Recovery program of the ACS for appropriate referrals. The patient should be encouraged to find a shop with a comfortable, supportive atmosphere that employs a certified prosthetics consultant. In general, medical supply shops are not recommended because often they do not have the appropriate resources to ensure the proper fitting of a prosthesis.

Prior to discharge from the hospital, the nurse usually provides the patient with a temporary, lightweight, cotton-filled form that can be worn until the surgical incision is well healed (4 to 6 weeks). After that, the patient can be fitted for a prosthesis. A breast prosthesis can provide a psychological benefit and assist the woman in resuming proper posture because it helps balance the weight of the remaining breast.

Special Issues in Breast Cancer Management

Implications of Genetic Testing

The rapid advancement in genetics not only has brought new knowledge about inherited breast cancer, but it has also raised potential ethical and psychosocial issues. Although the actual

testing for the *BRCA1* and *BRCA2* and several other genes that increase risk involves a simple blood or saliva test, ethical and psychosocial issues must first be addressed. Before undergoing genetic testing, a person should meet either with a clinician who has expertise in this area or with a certified genetic counselor to discuss risk factors as well as the benefits, sequelae, and limitations of testing.

How people react when they receive their actual test results is not always easy to predict. A negative test in a person who comes from a family with a known mutation may lead to enormous relief. However, a negative test in a family with no known mutation may be a source of undue reassurance; the possibility of existing genes that cannot yet be detected remains. A negative test may also lead to feelings of guilt in a person whose family members did not receive favorable test results; this is known as survivor's guilt. A positive test could act as a motivator in a person to pursue appropriate screening or treatment, or it could cause tremendous anxiety, depression, and worry.

In addition, test results may be ambiguous, leading to feelings of confusion and uncertainty. People must be informed that not all gene carriers develop breast cancer (incomplete penetrance) and that not all noncarriers are protected or immune.

People must be well informed of all issues and potential implications prior to undergoing genetic testing. Nurses play a role in educating and counseling patients and their family members about the implications of genetic testing. Nurses provide support and clarification and make referrals to appropriate specialists when indicated.

Pregnancy and Breast Cancer

Breast cancer during pregnancy is defined as breast cancer diagnosed during gestation or within 1 year of childbirth and occurs in 1 in 3000 women (NCCN, 2015). Because of increased levels of hormones produced during pregnancy and subsequent lactation, the breast tissue becomes tender and swollen, making it more difficult to detect a mass. If a mass is found during pregnancy, ultrasound is the preferred diagnostic method because it involves no exposure to radiation. If indicated, mammography with appropriate shielding, FNA, and biopsy can be performed. Modified radical mastectomy remains the most common form of surgical treatment. SLNB is typically not performed because of the unknown effects of the radioisotope and the blue dye on the fetus. Breast conservation treatment may be considered if the breast cancer is diagnosed during the third trimester. Radiation can then be delayed until after delivery because it is contraindicated during pregnancy. If a woman is close to term, a cesarean section may be performed as soon as maturation of the fetus allows and then treatment is initiated. If aggressive disease is detected early in pregnancy and chemotherapy is advised, termination of the pregnancy may be considered. If a mass is found while a woman is breast-feeding, she is urged to stop to allow the breast to involute (return to its baseline state) before any type of surgery is performed (NCCN, 2015).

Fertility issues and the future desire for children are major concerns of young women who are survivors of breast cancer. Most cancer therapies have a substantial morbidity on reproductive function, not only because they increase the risk of early menopause but also because they are associated with a decreased ovarian reserve and a loss of fertility. It is estimated that physiologic age of the ovaries in a survivor of cancer may be 10 years older than the actual chronologic age.

Chemotherapy causes a progressive dose-related depletion of ovarian follicles and granulosa cells that translates into oligomenorrhea and subsequent premature ovarian failure, ultimately leading to what is known as chemotherapy-induced amenorrhea (CIA). Regardless of the beneficial effects that hormonal changes can have as part of the adjuvant endocrine strategy, CIA is an adverse event to consider when selecting the best adjuvant treatment. Patients with cancer need to be informed about their reproductive future and options to preserve fertility before treatment (Ruddy & Ginsburg, 2014).

Quality of Life and Survivorship

With increased early detection and improved treatment modalities, women with breast cancer have become the largest group of cancer survivors. However, the treatment or simply the diagnosis of breast cancer may have long-term effects that negatively affect the patient and her family. The patient should be prepared early on for the potential long-term effects of the disease so that she has realistic expectations and can make informed decisions.

Survivors of breast cancer may experience a variety of issues as a result of their diagnosis and treatment. Estrogen withdrawal from chemotherapy-induced menopause and hormonal treatments can lead to a variety of symptoms, including hot flashes, vaginal dryness, urinary tract infections, weight gain, decreased sex drive, and increased risk of osteoporosis. HT to alleviate symptoms is contraindicated in women with breast cancer. Certain chemotherapeutic agents can cause long-term cardiac effects and neuropathy. In addition, patients may experience impaired cognitive functioning, such as difficulty concentrating (often referred to as "chemo brain"). Rare long-term effects of radiation can include pneumonitis, rib fractures, heart disease, and breast fibrosis or necrosis (Harris & Morrow, 2014). Long-term sequelae after breast surgery may include lymphedema (mainly after ALND), pain, and sensory disturbances. Once lymphedema develops, it tends to be a chronic problem, so prevention strategies (discussed earlier) are vital. Weight gain and infections are risk factors for lymphedema (Ahn & Port, 2016). Nurses need to encourage patients to maintain an active lifestyle and avoid weight gain.

Long-term psychosocial sequelae may include fears of recurrence, mood changes (e.g., worry, sadness, anger, frustration), an increased sense of vulnerability, uncertainty, feelings of loss (e.g., fertility), concerns about body image, self-concept, and sexuality; emotional distress related to role adjustments and family response; and concerns about finances and employment. Depression and anxiety have been documented in 20% to 30% of women with breast cancer. Interventions should be targeted to meet informational needs, manage uncertainty, control symptoms, address cultural differences, and enhance social and emotional support (Heinz, & Williams, 2015); (Ligabel & Denlinger, 2013).

Gerontologic Considerations

Breast cancer reconstruction in older women with breast cancer is a feasible option that should be offered to patients. Most women tolerate the procedure well and have good cosmetic outcomes. Patients can be offered both implant-based reconstruction and autologous tissue transfer with minimal complications as long as appropriate preoperative selection criteria are used. The safety of reconstruction, together with increase in life expectancy and healthier lifestyles, makes breast reconstruction after mastectomy desirable at any age (NCCN, 2015).

A thorough assessment must be performed before any treatment is initiated, and careful monitoring must occur throughout the course of treatment to avoid complications. The physical and psychosocial assessment of the older woman should include general health, currently existing comorbidities, performance status, cognitive status, current medications, available resources, and support systems.

Breast Health of Women with Disabilities

Disparities in obtaining a mammogram at recommended screening intervals persist for many women, including those with disabilities. Prevalence of self-reported use of mammography is lower for women with a disability. Efforts to reduce disparities in breast cancer screening might be more effective if all segments of the population are targeted. Possible barriers to the use of mammography in women with disabilities include physical inaccessibility of office space and medical equipment; limited transportation and parking options; and time and assistance constraints associated with undressing, transferring, and positioning for medical examinations. Lesbian, gay, bisexual, transgender and those questioning their gender may also be uncomfortable with the health care system and avoid screening (Bosse, Nesteby, & Randall, 2015). To promote health and wellness, health agencies, providers, and health care plans must promote cancer prevention and educational programs that are inclusive and responsive to the special needs of women with disabilities (Swaine, Parish, Luken, et al., 2014).

An essential role of the nurse is to assist all women, including those with disabilities, to identify accessible health screening and to advocate for greater accessibility of imaging centers and other health care facilities. Reminding women of the need for recommended clinical breast examinations and mammograms is an important part of nursing care.

Male Breast Cancer

The lifetime risk of breast cancer in men is about 1 in 1000. The number of breast cancer cases in men relative to the population has been fairly stable over the past 30 years. Nearly 2350 new cases of invasive breast cancer were expected to be diagnosed in men in 2015 (ACS, 2015). Although breast carcinoma in both genders shares certain characteristics, notable differences have emerged. Familial cases in men usually have *BRCA2* rather than *BRCA1* mutations. Klinefelter syndrome, a chromosomal condition reflecting decreased testosterone levels, is the strongest risk factor for developing male breast carcinoma. Presentation is usually a painless lump, but is often late, with more than 40% of individuals having stage III or IV disease. When survival is adjusted for age at diagnosis and stage of disease, outcomes for male and female patients with breast cancer is similar (Jain & Gradishar, 2014).

Early detection is uncommon in male breast cancer because of the rare nature of the disease. Often, neither patient nor provider suspects male breast cancer early in its development. Treatment generally consists of a total mastectomy with either SLNB or ALND. As in women with breast cancer, prognosis depends on the stage of disease at presentation. Involvement of the axillary lymph nodes is the most important prognostic indicator. Male breast cancers are very likely to be ER+, and tamoxifen, although it has several side effects, is a mainstay of treatment.

Because breast cancer is primarily a disease of women, men may feel that a certain stigma is attached to their diagnosis. Health care professionals must be sensitive to their needs and provide information and support.

GYNECOLOGIC MALINANCIES

Gynecologic cancer is any cancer that starts in a woman's reproductive organs (CDC, 2014).

The projected incidence of female reproductive cancer in India includes about 75,000 new cases of breast cancer, 70,000 new cases of cervical uteri, 3–8% of ovarian cancer, 0.5–4.8% of carpus uteri, and 1–3% of vulvar and gestational trophoblastic tumors. Ovarian cancer is responsible for 58% (75,000 women annually) of all cancer deaths in women and is the leading cause of death in female reproductive cancers (Devi, 2009).

Although some cancers are difficult to detect or prevent, annual pelvic examination with a Pap smear is a painless and relatively inexpensive method of early detection (CDC, 2014). Primary providers can encourage women to follow this health practice by providing examinations that are educational and supportive and offer women an opportunity to ask questions and clarify misinformation.

Women diagnosed with gynecologic malignancies experience anxiety related to their prognosis. The occurrence of physical symptoms may cause more psychological distress. Intervention directed toward physical and psychological symptoms requires a multidisciplinary approach.

Cancer of the Cervix

Death from cervical cancer is less common due to early detection of cell changes by Pap smear (CDC, 2014). However, it is still the third most common female reproductive cancer and is estimated to affect nearly 13,000 women in the United States every year (CDC, 2014). Risk factors are presented in Chart 58-20.

In South Asia, India has highest age-standardized incidence rate of cervical cancer (22/100,000 women per year). As per the most recent available data, about 122,844 women are diagnosed with cervical cancer every year and 67,477 women die of the disease (ICO Information Centre on HPV and Cancer, 2014). The recent National Centre for Disease Informatics and Research (NCDIR) data show that between 2009 and 2011, Aizawl district in the northeastern part of India had the highest levels of cervical cancer at an age-adjusted rate of 24.3, followed by Barshi at 19.5 and Bangalore at 18.9 (NCRP, 2014). HPV prevalence among cervical cancer patients in India has varied from 87.8% to 96.67% (Sowjanya, Jain, Poli, et al., 2005) (Kulkarni, Kulkarni, Vastrad, et al., 2011) (Gheit, Vaccarella, Schmitt, et al., 2009) (Basu, Roychowdhury, Bafna, et al., 2009).

Preventive measures include regular pelvic examinations and Pap tests for all women, especially older women past childbearing age. Preventive counseling should encourage delaying first intercourse, avoiding HPV infection, engaging only in safer sex, ceasing smoking, and receiving HPV immunization.

There are several different types of cervical cancer. Most of these cancers are squamous cell carcinomas, and the rest are adenocarcinomas or mixed adenosquamous carcinomas. Adenocarcinomas begin in mucus-producing glands and are often due to HPV infection. Most cervical cancers, if not detected and treated, spread to regional pelvic lymph nodes, and local recurrence is not uncommon.

Chart 58-20 RISK FACTORS

Cervical Cancer

- Chronic cervical infection
- Early childbearing
- Exposure to diethylstilbestrol in utero
- Exposure to human papillomavirus, types 16 and 18
- Family history of cervical cancer
- HIV infection and other causes of immune deficiency
- Low socioeconomic status (may be related to early marriage and early childbearing)
- Nutritional deficiencies (folate, beta-carotene, and vitamin C levels are lower in women with cervical cancer than in women without it)
- Overweight status
- Prolonged use of oral contraceptives
- Sexual activity:
  - Multiple sex partners
  - Early age (<20 years) at first coitus (exposes the vulnerable young cervix to potential viruses from a partner)
- Sexual contact with men whose partners have had cervical cancer
- Sex with uncircumcised men
- Smoking and exposure to secondhand smoke

HIV, human immune deficiency virus.

Adapted from American Cancer Society. (2015b). Cervical Cancer. Retrieved on 11/27/2015 at www.cancer.org/acs/groups/cid/documents/webcontent/003094-pdf.pdf; Barakat, R. R., Berchuk, A., & Markman, M., et al. (Eds). (2013). Principles and practice of gynecologic oncology (6th ed). Philadelphia, PA: Lippincott Williams & Wilkins

Clinical Manifestations

Early cervical cancer rarely produces symptoms. If symptoms are present, they may go unnoticed as a thin, watery vaginal discharge often noticed after intercourse or douching. When symptoms such as discharge, irregular bleeding, or pain or bleeding after sexual intercourse occur, the disease may be advanced. Advanced disease should not occur if all women have access to gynecologic care and avail themselves to it. The nurse's role in access to care and its utilization is crucial.

In advanced cervical cancer, the vaginal discharge gradually increases and becomes watery and, finally, dark and foul smelling from necrosis and infection. The bleeding, which occurs at irregular intervals between periods (metrorrhagia) or after menopause, may be slight (just enough to spot the undergarments) and occurs usually after mild trauma or pressure (e.g., intercourse, douching, or bearing down during defecation). As the disease continues, the bleeding may persist and increase. Leg pain, dysuria, rectal bleeding, and edema of the extremities signal advanced disease.

As the cancer advances, it may invade the tissues outside the cervix, including the lymph glands anterior to the sacrum. In one third of patients with invasive cervical cancer, the disease involves the fundus. The nerves in this region may be affected, producing excruciating pain in the back and the legs that is relieved only by large doses of opioid analgesic agents. If the disease progresses, it often produces extreme emaciation and anemia that usually is accompanied by fever (due to secondary infection and abscesses in the ulcerating mass) and by fistula formation. Because the survival rate for in situ cancer is 100% and the rate for women with more advanced stages of cervical cancer decreases dramatically, early detection is essential.

Assessment and Diagnostic Findings

Diagnosis may be made on the basis of abnormal Pap smear results, followed by biopsy results identifying severe dysplasia (cervical intraepithelial neoplasia type III [CIN III], high-grade squamous intraepithelial lesions [HGSILs, also referred to as HSILs], or carcinoma in situ). HPV infections are usually implicated in these conditions. Carcinoma in situ is technically classified as severe dysplasia and is defined as cancer that has extended through the full thickness of the epithelium of the cervix, but not beyond. This is often referred to as preinvasive cancer.

In its very early stages, cervical cancer is found microscopically by Pap smear. In later stages, pelvic examination may reveal a large, reddish growth or a deep, ulcerating lesion. The patient may report spotting or bloody discharge.

When the patient has been diagnosed with invasive cervical cancer, clinical staging estimates the extent of the disease so that treatment can be planned more specifically and prognosis reasonably predicted. Staging is based on the International Federation of Gynecology and Obstetrics (FIGO) Staging Classification (Beckmann et al., 2014):

- Stage I, the carcinoma is strictly confined to the cervix.
- Stage II, the carcinoma invades beyond the uterus but not the pelvic wall or vagina.
- Stage III, the tumor spreads to the pelvic wall and/or the vagina, and/or causes hydronephrosis of the kidneys.
- Stage IV, the tumor has extended beyond the pelvis and involves the bladder or rectum.

Signs and symptoms are evaluated, and x-rays, laboratory tests, and special examinations, such as biopsy and colposcopy, are performed (Beckmann et al., 2014). Depending on the stage of the cancer, other tests and procedures may be performed to determine the extent of disease and appropriate treatment. These tests may include dilation and curettage (D&C), CT scan, MRI scan, IV urography, cystography, positron emission tomography (PET) scan, and barium x-ray studies. Treatment depends on the stage of the disease.

Medical Management

Precursor or Preinvasive Lesions

When precursor lesions, such as low-grade squamous intraepithelial lesions (LGSILs, also referred to as LSILs; CIN I and II or mild to moderate dysplasia), are found by colposcopy and biopsy, careful monitoring by frequent Pap smears or conservative treatment is possible. Conservative treatment may consist of monitoring, cryotherapy (freezing with liquid nitrogen), or laser therapy. A loop electrocautery excision procedure (LEEP) may also be used to remove abnormal cells. In this procedure, a thin wire loop with laser is used to cut away a thin layer of cervical tissue. LEEP is an outpatient procedure that usually is performed in a gynecologist's office; it takes only a few minutes. Analgesia is given before the procedure, and a local anesthetic agent is injected into the area. This procedure allows the pathologist to examine the removed tissue sample to determine if the borders of the tissue are disease free. Another procedure referred to as a cone biopsy or conization (removing a cone-shaped portion of the cervix) is performed when biopsy findings demonstrate CIN III or HGSIL (equivalent to severe dysplasia) and carcinoma in situ.

If preinvasive cervical cancer (carcinoma in situ) occurs when a woman has completed childbearing, a simple hysterectomy (removal of the uterus only) is usually recommended

(Beckmann et al., 2014). If a woman is pregnant or wishes to have children and invasion is less than 1 mm, conization may be sufficient. Frequent follow-up examinations are necessary to monitor for recurrence (Beckmann et al., 2014).

Patients who have precursor or premalignant lesions need reassurance that they do not have invasive cancer. However, the importance of close follow-up is emphasized because the condition, if untreated for a long time, may progress to cancer. Patients with cervical cancer in situ also need to know that this is usually a slow-growing and nonaggressive type of cancer that is not expected to recur after appropriate treatment.

Invasive Cancer

Treatment of invasive cervical cancer depends on the stage of the lesion, the patient's age and general health, and the judgment and experience of the provider. Surgery and radiation treatment (intracavitary and external) are most often used. Surgical procedures that may be used to treat cervical cancer are summarized in Chart 58-21. Robot-assisted technology for the treatment of cervical cancer is a rapidly growing alternative to more invasive surgical options with decreased length of stay, recovery time, decreased blood loss, and increase in total number of retrievable lymph nodes (ACOG, 2015c). Ethical issues often arise in the treatment of invasive cancers. These issues are summarized in Chart 58-22.

Frequent follow-up after surgery is imperative because the risk of recurrence is high and usually occurs within the first 2 years. Recurrences are often in the upper quarter of the vagina, and ureteral obstruction may be a sign. Weight loss, leg edema, and pelvic pain may be signs of lymphatic obstruction and metastasis.

Radiation, which is often part of treatment to reduce recurrent disease, may be delivered by an external beam or by brachytherapy (method by which the radiation source is placed near the tumor in a sealed source) or both. The field to be irradiated as well as the dose and method of radiation are determined by stage, volume of tumor, and lymph node involvement (Beckmann et al., 2014).

Chart 58-21

Surgical Procedures for Cervical Cancer

- Total hysterectomy—removal of the uterus, cervix, and ovaries
- Radical hysterectomy—removal of the uterus, ovaries, fallopian tubes, proximal vagina, and bilateral lymph nodes through an abdominal incision (*Note*: "Radical" indicates that an extensive area of the paravaginal, paracervical, parametrial, and uterosacral tissues is removed with the uterus.)
- Radical vaginal hysterectomy—vaginal removal of the uterus, ovaries, fallopian tubes, and proximal vagina
- Bilateral pelvic lymphadenectomy—removal of the common iliac, external iliac, hypogastric, and obturator lymphatic vessels and nodes
- Pelvic exenteration—removal of the pelvic organs, including the bladder or rectum and pelvic lymph nodes, and construction of diversional conduit, colostomy, and vagina
- Radical trachelectomy—removal of the cervix and selected nodes to preserve childbearing capacity in a woman of reproductive age with cervical cancer

Adapted from American Cancer Society. (2015b). *Cervical Cancer*. Retrieved on 11/27/2015 at www.cancer.org/acs/groups/cid/documents/webcontent/003094-pdf.pdf; Barakat, R. R., Berchuk, A., & Markman, M., et al. (Eds). (2013). Principles and practice of gynecologic oncology (6th ed). Philadelphia, PA: Lippincott Williams & Wilkins

A variety of chemotherapeutic approaches are used to treat advanced cervical cancer. They are often used in combination with surgery and radiation. Vaginal stenosis is a frequent side effect of radiation. Preventive therapy (i.e., vaginal dilator) can be used to avoid severe permanent vaginal stenosis.

Some patients with recurrences of cervical cancer are considered for pelvic exenteration, in which several pelvic organs are removed. This is a complex, extensive surgical procedure that is reserved for women with a high likelihood of cure. Unilateral leg edema, sciatica, and ureteral obstruction indicate likely disease progression. Patients with these symptoms have advanced disease and are not considered

Chart 58-22 ETHICAL DILEMMA

What if the Patient Refuses to Autonomously Make Decisions?

Case Scenario

You work on a gynecology-oncology unit in a small rural community hospital. The patient, a 60-year-old woman, has been admitted with a diagnosis of cancer of the vulva. She has been married to her husband since she was 16 years old. Both the patient and her husband are Mexican migrant workers. It has been determined that her disease is advanced and that she will need surgical removal of the vulva and radical node dissection. In addition, it is likely she will need chemotherapy and may be a candidate for enrollment in a clinical trial. After the treatment is explained using a medical translator, she asks her physician, "What would you do if it was your mother?" The physician reiterates the information about the surgery, and the patient states, "It is up to my husband to decide; he always makes our important decisions."

Discussion

Some cultures adhere to paternalistic tenets; the male "head of household" makes all major decisions, including health care decisions. The patient may be adhering to her cultural norms when she tells you that she will acquiesce to whatever decision her husband makes for her. Arguably, however, she may feel coerced or obligated to acquiesce to his decisions.

Analysis

- Describe the ethical principles that are in conflict in this case (see Chapter 2, Chart 2-3). Which principle should have preeminence as you proceed with your assessment of this patient?
- Describe any concerns you may have regarding beneficence and autonomy.
- Discuss any concerns that you may have about the patient's refusal to make a health care decision that will have a significant impact on her life. Assume that you have spoken in private with the patient and have verified that she understands that failure to have this surgery may put her life in jeopardy but she still refuses to make the decision. How can you professionally reconcile her decision to put her life at greater risk so that she may adhere to her cultural norms (i.e., decision-making done solely by the spouse)? Does this type of decision truly preserve her autonomy?
- What resources are available to help you, your professional colleagues, the patient, and her husband reach consensus on the best treatment or care in this situation?

candidates for this major surgical procedure. Surgery is complex because it is performed close to the bowel, bladder, ureters, and great vessels. Possible complications include pulmonary embolism (PE), pulmonary edema, myocardial infarction, cerebrovascular disease, hemorrhage, sepsis, small bowel obstruction, fistula formation, obstruction of the ileal conduit, bladder dysfunction, and pyelonephritis, most often in the first 18 months postoperatively. Vein constriction must be avoided postoperatively. Patients with varicose veins or a history of thromboembolic disease may be treated prophylactically with heparin. Antiembolism stockings are prescribed to reduce the risk of deep vein thrombosis (DVT). Nursing care of these patients is complex and requires coordination and care by experienced health care professionals.

Cancer of the Uterus (Endometrium)

Over the last decade there has been an increase in both the incidence and death rates of cancer of the uterine endometrium (fundus or corpus), possibly because of increased lifespan and coexisting comorbidities. Endometrial cancer is the most common gynecological malignancy in the West, but in India, the incidence rates are as low as 4.3 per 100,000 (Balasubramaniam, Sushma, Rasika, et al., 2013). Most of these cancers present at an early stage and are associated with a good prognosis (Maheshwari, Kumar, & Mahantshetty, 2016).

Many women with endometrial cancer have obesity, which increases the risk of morbidity and mortality from this disease. Cumulative exposure to estrogen is considered the major risk factor (see Chart 58-23). This exposure occurs with the use of estrogen therapy without the use of progestin, early menarche, late menopause, nulliparity, and anovulation. Other risk factors include infertility, diabetes, and the use of tamoxifen. Tamoxifen, which is taken for treatment or prevention of breast cancer, may cause proliferation of the uterine lining (ACOG, 2015d). Women who take tamoxifen should be monitored by their oncologists and/or gynecologic health care providers.

Pathophysiology

Most uterine cancers are endometrioid (i.e., originating in the lining of the uterus). There are two types. Type 1, which accounts for about 90% of cases, is estrogen dependent. It is usually low grade with a favorable prognosis. Type 2, which occurs in about 10% of cases, is high grade and usually serous cell or clear cell. Type 2 is considered to be estrogen independent. Older and African-American women are at higher risk for type 2 (ACOG, 2015d); (Beckmann et al., 2014).

Chart 58-23 RISK FACTORS

Uterine Cancer

- Age—usually >50 years; average age, 63 years
- Obesity that results in increased estrone levels (related to excess weight) resulting from conversion of androstenedione to estrone in body fat, which exposes the uterus to unopposed estrogen
- Unopposed estrogen therapy (estrogen used without progesterone, which offsets the risk of unopposed estrogen)
- Other—nulliparity, truncal obesity, early menarche, late menopause (after 52 years of age) and the use of tamoxifen

Adapted from American College of Obstetricians and Gynecologists. (2015d). Practice Bulletin No. 149: Endometrial cancer. Obstetrics and Gynecology, 125(4), 1006–10026.

Assessment and Diagnostic Findings

All women should be encouraged to have annual checkups, including a gynecologic examination. Any woman who is experiencing irregular bleeding should be evaluated promptly. If a menopausal woman experiences bleeding, an endometrial aspiration or biopsy is performed to rule out hyperplasia, which is a possible precursor of endometrial cancer. The procedure is quick and usually not painful. Transvaginal ultrasound can also be used to measure the thickness of the endometrium (ACOG, 2015d). (Women who are postmenopausal should have a very thin endometrium due to low levels of estrogen; a thicker lining warrants further investigation.) A biopsy or aspiration for tissue pathology is diagnostic.

Cytologic Test for Cancer (Pap Smear)

The Papanicolaou (Pap) smear is used to detect cervical cancer. Cervical secretions are gently removed from the cervical os and may be transferred to a glass slide and fixed immediately by spraying with a fixative or immersed in solution. If the Pap smear reveals atypical cells, the liquid method allows for HPV testing.

Terminology used to describe findings includes the following categories:

- No abnormal or atypical cells
- Atypical squamous cells of undetermined significance
- Inflammatory reactions and microbes identified
- Positive deoxyribonucleic acid (DNA) test for HPV
- Precancerous and cancerous lesions of the cervix identified

The patient may incorrectly assume that an abnormal Pap smear signifies cancer. If the Pap smear (liquid immersion method) shows atypical cells and no high-risk HPV types, the next Pap smear is performed in 1 year. If a specific infection is causing inflammation, it is treated appropriately, and the Pap smear is repeated. If the repeat Pap smear reveals atypical squamous cells with high-risk HPV types, colposcopy may be indicated. Pap smears that indicate precancerous lesions should be repeated in 4 to 6 months and colposcopy performed if the lesion has not resolved. Patients with Pap smears that indicate cancerous lesions require prompt colposcopy (Fischbach & Dunning, 2015).

If the Pap smear results are abnormal, prompt notification, evaluation, and treatment are crucial. Notification of patients is often the responsibility of nurses in a women's health care practice or clinic. Pap smear follow-up is essential because it can prevent cervical cancer. Interventions are tailored to meet the needs and health beliefs of the particular patient. Intensive telephone counseling, tracking systems, brochures, videos, and financial incentives have all been used to encourage follow-up. The nurse provides clear explanations and emotional support along with a carefully designed setting-specific follow-up protocol designed to meet the needs of the patient.

Colposcopy and Cervical Biopsy

If the cervical cytology screening result requires evaluation, a colposcopy is performed. The colposcope is an instrument with a magnifying lens that allows the examiner to visualize the cervix and obtain a sample of abnormal tissue for analysis (Fischbach & Dunning, 2015). Nurse practitioners and gynecologists require special training in this diagnostic technique.

After inserting a speculum and visualizing the cervix and vaginal walls, the examiner applies acetic acid to the cervix. Subsequent abnormal findings that indicate the need for biopsy

include leukoplakia (white plaque visible before applying acetic acid), acetowhite tissue (white epithelium after applying acetic acid), punctation (dilated capillaries occurring in a dotted or stippled pattern), mosaicism (a tilelike pattern), and atypical vascular patterns. If biopsy specimens show precancerous cells, the patient usually requires cryotherapy, laser therapy, or a cone biopsy (excision of an inverted tissue cone from the cervix).

Cryotherapy and Laser Therapy

Cryotherapy (freezing cervical tissue with nitrous oxide) and laser treatment are used in the outpatient setting. Cryotherapy may result in cramping and occasional feelings of faintness (vasovagal response). A watery discharge is normal for a few weeks after the procedure as the cervix heals; however, excessive bleeding, pain, or fever should be reported to the primary provider (Fischbach & Dunning, 2015).

Cone Biopsy and Loop Electrosurgical Excision Procedure

If endocervical curettage findings indicate abnormal changes or if the lesion extends into the canal, the patient may undergo a cone biopsy. This can be performed surgically or with a procedure called *loop electrosurgical excision procedure* (LEEP), which uses a laser beam (Fischbach & Dunning, 2015).

Usually performed in the outpatient setting, LEEP is associated with a high success rate in removal of abnormal cervical tissue. The gynecologist excises a small amount of cervical tissue, and the pathologist examines the borders of the specimen to determine if disease is present. A patient who has received anesthesia for a surgical cone biopsy is advised to rest for 24 hours after the procedure and to leave any vaginal packing in place until it is removed (usually the next day). The patient is instructed to report any excessive bleeding.

The nurse or primary provider provides guidelines regarding postoperative sexual activity, bathing, and other activities. Because open tissue may be potentially exposed to HIV and other pathogens, the patient is cautioned to avoid intercourse until healing is complete and verified at follow-up.

Endometrial (Aspiration) Biopsy

Endometrial biopsy, a method of obtaining endometrial tissue, is performed as an outpatient procedure. This procedure is usually indicated in cases of midlife irregular bleeding, postmenopausal bleeding, and irregular bleeding while taking hormone therapy (HT) or tamoxifen. A tissue sample obtained through biopsy permits diagnosis of cellular changes in the endometrium. The only absolute contraindication to an endometrial biopsy is the presence of a viable and desired pregnancy (Del Priore, 2015).

Women who undergo endometrial biopsy may experience slight discomfort. The examiner may apply a tenaculum (a clamplike instrument that stabilizes the uterus) after the pelvic examination and then inserts a thin, hollow, flexible suction tube (Pipelle or sampler) through the cervix into the uterus.

Findings on aspiration may include normal endometrial tissue, hyperplasia, or endometrial cancer. Simple hyperplasia is an overgrowth of the uterine lining and is usually treated with progesterone. Complex hyperplasia, which refers to overgrowth of cells with abnormal features, is a risk factor for uterine cancer and is treated with progesterone and careful follow-up. Women who are overweight, who are older than 45 years, who have a history of nulliparity and infertility, or who have a family history of colon cancer seem to be at higher risk for hyperplasia.

Dilation and Curettage

Dilation and curettage (D&C) may be diagnostic (identifies the cause of irregular bleeding) or therapeutic (often temporarily stops irregular bleeding). The cervical canal is widened with a dilator, and the uterine endometrium is scraped with a curette. The purpose of the procedure is to secure endometrial or endocervical tissue for cytologic examination, to control abnormal uterine bleeding, and as a therapeutic measure for incomplete abortion.

Because D&C is usually carried out under anesthesia and requires surgical asepsis, it is usually performed in the operating room. However, it may take place in the outpatient setting with the patient receiving a local anesthetic supplemented with diazepam (Valium) or midazolam (Versed).

The nurse explains the procedure, preparation, and expectations regarding postoperative discomfort and bleeding. The patient is instructed to void before the procedure. The patient is placed in the lithotomy position, the cervix is dilated with a dilating instrument, and endometrial scrapings are obtained by a curette. A perineal pad is placed over the perineum after the procedure, and excessive bleeding is reported. No restrictions are placed on dietary intake. If pelvic discomfort or low back pain occurs, mild analgesic medications usually provide relief. The primary provider indicates when sexual intercourse may be safely resumed. To reduce the risk of infection and bleeding, most gynecologists advise no vaginal penetration or use of tampons for 2 weeks.

Medical Management

Treatment for endometrial cancer consists of surgical staging, total or radical hysterectomy (discussed later in this chapter), and bilateral salpingo-oophorectomy and lymph node sampling. Laparoscopy or a robot-assisted laparoscopic surgery is less invasive than abdominal surgery (ACOG, 2015d). Lymph node sampling and visualization of the peritoneum can be accomplished in many women in this manner. Cancer antigen 125 (CA-125) levels must be monitored, because elevated levels are a significant predictor of extrauterine disease or metastasis. Depending on the stage, the therapeutic approach is individualized and is based on stage, type, differentiation, degree of invasion, and node involvement. Radiation may be used in the form of external-beam radiation or vaginal brachytherapy (ACOG, 2015d). Whole pelvis radiotherapy may be used if there is any spread beyond the uterus. Recurrent cancer usually occurs inside the vaginal vault or in the upper vagina, and metastasis usually occurs in lymph nodes or the ovary. Recurrent lesions in the vagina are treated with surgery and radiation. Recurrent lesions beyond the vagina are treated with hormonal therapy or chemotherapy. Progestin therapy is used frequently. Patients should be prepared for such side effects as nausea, depression, rash, or mild fluid retention with progestin therapy.

Cancer of the Vulva

Primary cancer of the vulva is rare, representing 5% of all gynecologic malignancies and 1% of cancer in women (Zweizig, Korets, & Cain, 2014). According to American Cancer Society (ACS, 2015a), more than 5150 new cases of vulvar carcinoma occur each year, with more than 1080 deaths. It is most common in women who are postmenopausal, although its incidence in younger women is increasing. Possible risk factors include smoking, HPV infection, HIV infection, and

immunosuppression. Squamous cell carcinoma accounts for most primary vulvar tumors. Less common are Bartholin gland cancer, vulvar sarcoma, and malignant melanoma. Little is known about what causes this disease; however, increased risk may be related to chronic vulvar irritation. In younger women, HPV infection may be implicated, especially types 16, 18, and 31. Prevention includes delaying onset of sexual activity to avoid early exposure to HPV, administration of the HPV vaccine, and avoidance of smoking. Regular pelvic examinations, Pap smears, and vulvar self-examination are helpful in early detection. Women with persistent irritation or itching should be encouraged to seek evaluation.

Clinical Manifestations

Vulvar cancers are rarely asymptomatic (Zweizig et al., 2014). Long-standing pruritus and soreness are the most common symptoms of vulvar cancer. Itching occurs in half of all patients with vulvar malignancy. Bleeding, dysuria, foul-smelling discharge, and pain may also be present and are usually signs of advanced disease. Cancerous lesions of the vulva are visible and accessible and grow relatively slowly. Early lesions appear as a chronic dermatitis; later, patients may note a lump that continues to grow and becomes a hard, ulcerated, cauliflower like growth. Biopsy should be performed on any vulvar lesion that persists, ulcerates, or fails to heal quickly with proper therapy. Vulvar malignancies may appear as a lump or mass, redness, or a lesion that fails to heal.

Medical Management

Vulvar intraepithelial lesions are preinvasive and are also called *vulvar carcinoma in situ.* They may be treated by local excision, laser ablation, application of chemotherapeutic creams, or cryosurgery.

When invasive vulvar carcinoma exists, treatment may include wide excision of the vulva and vulvectomy (removal of the vulva). An effort is made to individualize treatment, depending on the extent of the disease. A wide excision is performed only if lymph nodes are normal. More pervasive lesions require vulvectomy with deep pelvic node dissection. Vulvectomy is very effective at prolonging life but is frequently followed by complications (i.e., scarring, wound breakdown, leg swelling, vaginal stenosis, or rectocele). To reduce complications, only necessary tissue is removed. External-beam radiation may be used, resulting in sunburnlike irritation that usually resolves in 6 to 12 months. Laser therapy and chemotherapy are other possible treatment options.

If a widespread area is involved or the disease is advanced, a radical vulvectomy with bilateral groin dissection may be performed. Antibiotic and heparin prophylaxis may be prescribed preoperatively and continued postoperatively to prevent infection, DVT, and PE. Sequential compression devices (SCDs) are applied to reduce the risk of venous thromboembolism (VTE).

Although the role of systemic chemotherapy in the treatment of vulvar cancer remains to be determined, chemotherapy may be helpful when used in combination with radiation therapy in treatment for advanced disease. The combination of radiation and chemotherapy may reduce the size of the cancer, resulting in less extensive subsequent surgery (Zweizig et al., 2014).

Clinical trials to determine the most effective treatment are difficult to conduct because there are few patients with this condition. Morbidity with recurrence of the disease is high, and patterns of recurrence vary. Reconstruction after vulvectomy is performed by plastic surgeons when appropriate and desired.

Nursing Management

Obtaining the Health History

The health history is a valuable tool for establishing rapport with the patient. The reason the patient is seeking health care is apparent. What the nurse can tactfully elicit is the reason a delay, if any, occurred in seeking health care—for example, because of modesty, economics, denial, neglect, or fear (partners who are abusive sometimes prevent women from seeking health care). Factors involved in any delay in seeking health care and treatment may also affect recovery. The patient's health habits and lifestyle are assessed, and her receptivity to education is evaluated. Psychosocial factors are also assessed. Preoperative preparation and psychological support begin at this time.

Providing Preoperative Care

Relieving Anxiety

Prior to surgery, the patient must be allowed time to talk and ask questions. Fear often decreases when a woman who is to undergo wide excision of the vulva or vulvectomy learns that the possibility for subsequent sexual relations is good. The nurse reinforces the information the surgeon has given to the patient and addresses the patient's questions and concerns.

Preparing Skin for Surgery

Skin preparation may include cleansing the lower abdomen, inguinal areas, upper thighs, and vulva with chlorhexidine for several days before the surgical procedure. The patient may be instructed to do this at home.

Providing Postoperative Care

Relieving Pain

Because of the wide excision, the patient may experience severe pain and discomfort even with minimal movement. Therefore, analgesic agents are given preventively (i.e., around the clock at designated times) to relieve pain, increase the patient's comfort level, and allow mobility. Patient-controlled analgesia (see Chapter 9) may be used to relieve pain and promote patient comfort. Careful positioning using pillows usually increases comfort, as do soothing back rubs. A low Fowler position or, occasionally, a pillow placed under the knees reduces pain by relieving tension on the incision; however, efforts must be made to avoid pressure behind the knees, which increases the risk of DVT. Positioning the patient on her side, with pillows between her legs and against the lumbar region, provides comfort and reduces tension on the surgical wound.

Improving Skin Integrity

A pressure-reducing mattress may be used to prevent pressure ulcers. Moving from one position to another requires time and effort; the use of an overbed trapeze bar may help the patient move herself more easily. The extent of the surgical incision and the type of dressing are considered when choosing strategies to promote skin integrity. Intact skin needs to be protected from drainage and moisture. Dressings are changed as needed to ensure patient comfort, to perform wound care and irrigation (if prescribed), and to permit observation of the surgical site.

The wound is usually cleansed daily with warm, normal saline irrigations or other antiseptic solutions as prescribed, or a

transparent dressing may be in place over the wound to minimize exposure to the air and subsequent pain. The appearance of the surgical site and the characteristics of drainage are assessed and documented. After the dressings are removed, a bed cradle may be used to keep the bed linens away from the surgical site.

Supporting Positive Sexuality and Sexual Function

The patient who undergoes vulvar surgery usually experiences concerns about body image, sexual attractiveness, and functioning. Establishing a trusting nurse–patient relationship is important for the patient to feel comfortable with expressing her concerns and fears. The patient is encouraged to discuss her concerns with her sexual partner as well.

Because alterations in sexual sensation and functioning depend on the extent of surgery, the nurse needs to know about any structural and functional changes resulting from the surgery. Referral of the patient and her partner to a sex counselor may help them address these changes and resume satisfying sexual activity.

Monitoring and Managing Potential Complications

Location, extent, and exposure of the surgical site and incision put the patient at risk for contamination of the site, infection and sepsis. The patient is monitored closely for local and systemic signs and symptoms of infection: purulent drainage, redness, increased pain, fever, and increased white blood cell count. The nurse assists in obtaining specimens for culture if infection is suspected and administers antibiotic agents as prescribed. Hand hygiene—always a crucial infection-preventing measure—is of particular importance along with wearing masks whenever there is an extensive area of exposed tissue. Catheters, drains, and dressings are handled carefully with gloves on to avoid cross-contamination. A low-residue diet prevents straining on defecation and wound contamination.

The patient is at risk for complications of VTE, which include DVT and PE, because of the positioning required during surgery, postoperative edema, and the immobility needed to promote healing. SCDs are applied, and other prophylactic measures may be prescribed for patients at high risk. The patient is encouraged and reminded to perform ankle exercises to minimize venous pooling, which leads to VTE. The patient is encouraged and assisted in changing positions by using the overbed trapeze bar. Pressure behind the knees is avoided when positioning the patient, because this may increase venous pooling. The patient is assessed for signs and symptoms of DVT (leg pain, redness, warmth, edema) and PE (chest pain, tachycardia, dyspnea). Fluid intake is encouraged to prevent dehydration, which also increases the risk of DVT.

The extent of the surgical incision and possibly wide excision of tissue increase the risk of postoperative bleeding and hemorrhage. Pressure dressings are applied after surgery to minimize this risk.

Nursing Alert: The patient must be monitored closely for signs of hemorrhage and resulting hypovolemic shock. These signs may include decreased blood pressure; increased pulse rate; decreased urine output; decreased mental status; and cold, clammy skin.

If hemorrhage and shock occur, interventions include fluid replacement, blood component therapy, and vasopressor medications. Laboratory results (e.g., hematocrit and hemoglobin levels) and hemodynamic monitoring are used to assess the patient's response to treatment. Depending on the specific cause of hemorrhage, the patient may be returned to the operating room. See Chapter 8 for a detailed discussion of shock.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care

Preparing the patient for hospital discharge begins before hospital admission. The patient and family are informed about what to expect during the immediate postoperative and recovery periods. Depending on the changes resulting from the surgery, the patient and her family may need instruction about wound care, urinary catheterization, and possible complications. The patient is encouraged to share her concerns and to assume increasing responsibility for her own care. She is encouraged and assisted in learning to care for the surgical site. A referral for transitional, home, or community-based care is made as indicated.

Nurses are in an ideal position to educate women about performing regular vulvar self-examinations. Using a mirror, patients can see what constitutes normal female anatomy and learn about changes that should be reported (e.g., lesions, ulcers, masses, and persistent itching). Nurses must urge women to seek health care if they notice anything abnormal, because vulvar cancer is one of the most curable of all malignant conditions.

Continuing and Transitional Care

Patients may be discharged early in their postoperative recovery to home or a subacute facility. During this phase, the patient's physical status and psychological responses to the surgery are assessed. In addition, the patient is assessed for complications and healing of the surgical site. During home visits, the nurse assesses the home to determine if modifications are needed to facilitate care. The home visit is used to reinforce previous education and to assess the patient's and the family's understanding of and adherence to the prescribed treatment strategies. Follow-up phone calls by the nurse to the patient between home visits are usually reassuring to the patient and family, who may be responsible for performing complex care procedures. Attention to the patient's psychological responses is important because the patient may become discouraged and depressed because of alterations in body image and a slow recovery. Communication between the nurse involved in the patient's immediate postoperative care and the home care nurse is essential to ensure continuity of care.

Cancer of the Vagina

Cancer of the vagina is uncommon, representing 1% to 3% of gynecologic cancers; it is usually squamous in origin (Beckmann et al., 2014). Malignant melanoma and sarcomas can occur. Most vaginal cancers are secondary and invasive at the time of diagnosis. Risk factors include previous cervical cancer, in utero exposure to diethylstilbestrol (DES), previous vaginal or vulvar cancer, previous radiation therapy, history of HPV, or pessary use. Any patient with previous cervical cancer should be examined regularly for vaginal lesions.

Vaginal pessaries, which are used to support prolapsed tissues, can be a source of chronic irritation. As such, they have been associated with vaginal cancer, but only when the devices were not cared for properly (i.e., the device was not cleaned regularly or the patient did not return to the primary provider regularly for vaginal examinations).

Patients often do not have symptoms but may report slight bleeding after intercourse, spontaneous bleeding, vaginal discharge, pain, and urinary or rectal symptoms (or both). Diagnosis is often by Pap smear. Encouraging close follow-up is the focus of nursing interventions with women who were exposed to DES in utero. Emotional support for mothers who received DES before its risks were discovered and their daughters who were exposed to DES in utero is essential.

Medical Management

Treatment of early lesions may include local excision, topical chemotherapy, or laser. Laser therapy is a common treatment option in early vaginal and vulvar cancer. Surgery for more advanced lesions depends on the size and the stage of the cancer. If radical vaginectomy is required, a vagina can be reconstructed with tissue from the intestine, muscle, or skin grafts. After vaginal reconstructive surgery and radiation, regular intercourse may be helpful in preventing vaginal stenosis. Water-soluble lubricants are helpful in reducing pain with intercourse (dyspareunia).

Following surgery, radiation therapy may be given by a variety of methods, including external-beam radiation, which is usually an outpatient procedure, or brachytherapy, which is internal radiation therapy. Internal radiation may be given with intracavitary radioactive material contained in a seed, wire, needle, or tube, which is placed into a cavity such as the uterus or vagina. Interstitial radiation is another type of internal radiation treatment in which the radioactive material is placed in or near the cancer but not into a body cavity and is used in cervical and ovarian malignancies. These treatments may be high dose for a short period or low dose, which may take longer. Treatment during hospitalization or during outpatient therapy depends on several factors, including the status of the patient and the mode of delivery.

Cancer of the Fallopian Tubes

Malignancies of the fallopian tube are the least common type of genital cancer (ACS, 2015a). Although this type of cancer can occur at any age, it is most common in women who are postmenopausal. Symptoms are often minimal, causing diagnosis to be made at an advanced stage (Beckmann et al., 2014). Symptoms include abdominal pain, abnormal bleeding, and vaginal discharge. An enlarged fallopian tube may be found on sonogram if dilated and fluid filled, or it may appear or be palpated as a mass. Surgery followed by radiation therapy is the usual treatment.

Cancer of the Ovary

Ovarian cancer is the leading cause of gynecologic cancer deaths worldwide including India. Despite careful physical examination, ovarian tumors are often difficult to detect because they are usually deep in the pelvis. No early screening mechanism exists at present. Tumor-associated antigens are helpful in determining follow-up care after diagnosis and treatment and to evaluate for recurrent disease but are not useful in early general screening (Beckmann et al., 2014).

Epidemiology

One in 70 women will develop ovarian cancer in her lifetime. The incidence of this type of cancer increases with age until 70 years, with most cases diagnosed by age 60 (Beckmann et al., 2014). The frequency of ovarian cancer is highest in industrialized countries and affects women of all races and ethnic backgrounds. Ovarian cancer has shown increased incidence rate in the recent years, and it is one of the most common malignancies affecting Indian women (Kaarthigeyan, 2012).

Family history is the most significant risk factor. Most cases are random, but 5% to 10% of ovarian cancers are familial (Beckmann et al., 2014). In most cases, the mutations are in the *BRCA1* gene and sometimes in the *BRCA2* gene. A family history in a first-degree relative (mother, daughter, or sister), older age, early menarche, late menopause, and obesity may increase the risk of ovarian cancer. However, most women who develop ovarian cancer have no known risk factors, and no definitive causative factors have been determined.

Patients with concerns about their family history should be referred to a cancer genetics center to obtain information and testing, if indicated. Women with inherited types of ovarian cancer tend to be younger when the diagnosis is made than the average age at the time of diagnosis. Hereditary nonpolyposis colorectal cancer (HNPCC, also known as Lynch syndrome) increases the risk of ovarian cancer 13-fold (Beckmann et al., 2014). Lifetime risk of developing ovarian cancer has been shown to be decreased by one half with long-term suppression (greater than 5 years) of ovulation through use of oral contraceptives (Beckmann et al., 2014).

Pathophysiology

Types of tumors include germ cell tumors, which arise from the cells that produce eggs and are the most common cause of ovarian cancer in women younger than 20 years (Beckmann et al., 2014); stromal cell tumors, which arise in connective tissue cells that produce hormones; and epithelial tumors, which originate from the outer surface of the ovary. Most ovarian cancers are epithelial in origin. Of the many different cell types in ovarian cancer, epithelial tumors constitute 90%. Germ cell and stromal tumors make up the other 10% (Beckmann et al., 2014).

Primary peritoneal carcinoma is closely related to ovarian cancer. Extraovarian primary peritoneal carcinoma (EOPPC) resembles ovarian cancer histologically and can occur in women with and without ovaries. Symptoms and treatment are similar. Because of the possibility of EOPPC, oophorectomy lessens the chance, but does not guarantee, that the patient will not develop carcinoma.

Clinical Manifestations

Symptoms of ovarian cancer are nonspecific and may include increased abdominal girth, pelvic pressure, bloating, back pain, constipation, abdominal pain, urinary urgency, indigestion, flatulence, increased waist size, leg pain, and pelvic pain. Symptoms are often vague, so many women tend to ignore them. Ovarian cancer is often silent, but enlargement of the abdomen from an accumulation of fluid is a common sign. All women with gastrointestinal symptoms without a known cause must be evaluated for potential ovarian cancer. Vague, undiagnosed, persistent gastrointestinal symptoms should alert the nurse to the possibility of an early ovarian malignancy. A palpable ovary in a woman who has gone through menopause is investigated immediately, because ovaries normally become smaller and less palpable after menopause.

Assessment and Diagnostic Findings

Any enlarged ovary must be investigated. Pelvic examination often does not detect early ovarian cancer, and pelvic imaging techniques are not always definitive. Ovarian tumors are classified as benign if there is no proliferation or invasion, borderline if there is proliferation but no invasion, and malignant if there is invasion. Of all new cases of ovarian tumors, 20% are classified as borderline and have low malignancy potential. However, by the time of diagnosis, most ovarian cancers are advanced (ACS, 2015a); (Beckmann et al., 2014).

Diagnostic test may include an MRI scan, transvaginal and pelvic ultrasound, chest x-rays, and a blood test for CA-125. An abdominal CT scan with and without contrast may be used to rule out metastasis (Beckmann et al., 2014).

Medical Management

Surgical Management

Surgical staging, exploration, and reduction of tumor mass are the basics of treatment. Surgical removal is the treatment of choice. Staging the tumor by the FIGO staging system is performed to guide treatment (see Chart 58-24). Likely treatment involves a total abdominal hysterectomy with removal of the fallopian tubes and ovaries and possibly the omentum (bilateral salpingo-oophorectomy and omentectomy), tumor debulking, para-aortic and pelvic lymph node sampling, diaphragmatic biopsies, random peritoneal biopsies, and cytologic washings. Postoperative management may include taxanes or platinum-based chemotherapy (discussed in the next section).

Borderline tumors resemble ovarian cancer but have much more favorable outcomes. Women diagnosed with this type of cancer tend to be younger (early 40s). A conservative surgical approach is used. The affected ovary is removed, but the uterus and the contralateral ovary may remain in place. Adjuvant therapy may not be warranted.

Pharmacologic Therapy

Chemotherapy is usually administered IV on an outpatient basis using a combination of platinum and taxane agents. Paclitaxel (Taxol) plus carboplatin (Paraplatin) are most often used because of their excellent clinical benefits and manageable toxicity. Leukopenia, neurotoxicity, and fever may occur.

Because paclitaxel often causes leukopenia, patients may need to take granulocyte colony-stimulating factor as well. Paclitaxel is contraindicated in patients with hypersensitivity to medications formulated in polyoxyethylated castor oil and in patients with baseline neutropenia. Because of possible adverse cardiac effects, paclitaxel is not used in patients with cardiac disorders. Hypotension, dyspnea, angioedema, and urticaria indicate severe reactions that usually occur soon after the first and second doses are given. Nurses who administer chemotherapy are prepared to assist in treating anaphylaxis. Patients should be prepared for inevitable hair loss.

Carboplatin may be used in the initial treatment and in patients with recurrence. It is used with caution in patients with renal impairment. Usually, six cycles are given. A positive clinical response is normalization of the tumor marker CA-125, negative CT results, and a normal physical and gynecologic examination.

Liposomal therapy, delivery of chemotherapy in a liposome, allows the highest possible dose of chemotherapy to the tumor target with a reduction in adverse effects. Liposomes are used as drug carriers because they are nontoxic, biodegradable, easily available, and relatively inexpensive. This encapsulated chemotherapy allows increased duration of action and better targeting. The encapsulation of doxorubicin (Doxil) lessens the incidence of nausea, vomiting, and alopecia. Patients must be monitored for bone marrow suppression and gastrointestinal and cardiac effects.

Combination IV and intraperitoneal chemotherapy is an option for some patients. However, this treatment is more toxic and side effects are more severe than regular chemotherapy (ACS, 2015c). Intraperitoneal chemotherapy is reserved for women with good kidney function (ACS, 2015c).

Genetic engineering and identification of cancer genes may make gene therapy a future possibility; gene therapy is under investigation. Emerging proteomic technologies (tissue-based protein analysis) look promising; they may allow earlier diagnosis and treatment decision making. New biomarkers need further validation, but protein signature patterns are now being tested. These technologies may result in individualized treatment strategies for epithelial ovarian cancer (ACS, 2015c).

Recurrence of ovarian cancer is common, and many patients may require treatment with multiple agents. Treatment is directed toward control of the cancer, maintenance of quality of life, and palliation. Liposomal preparations, intraperitoneal drug administration, anticancer vaccines, monoclonal antibodies directed against cancer antigens, gene therapy, and antiangiogenic treatments (to prevent formation of new blood vessels in an effort to halt growth of ovarian cancer) may be used in the treatment for recurrence.

Chart 58-24

Main Stages of Ovarian Cancer

I. Cancer is contained within the ovary (or ovaries).
II. Cancer is in one or both ovaries and has involved other organs (i.e., uterus, fallopian tubes, bladder, the sigmoid colon, or the rectum) within the pelvis.
III. Cancer involves one or both ovaries, and one or both of the following are present: (1) cancer has spread beyond the pelvis to the lining of the abdomen; (2) cancer has spread to lymph nodes.
IV. The most advanced stage of ovarian cancer. Cancer is in one or both ovaries. There is distant metastasis to the liver, lungs, or other organs outside the peritoneal cavity; ovarian cancer cells in the pleural cavity are evidence of stage IV disease.

Adapted from Beckmann, C. R., Ling, F. W., Herbert, W. N., et al. (Eds). (2014). Obstetrics and gynecology (7th ed.). Philadelphia, PA: Wolters Kluwer.

Nursing Management

Nursing measures involve those related to the patient's treatment plan, which may include surgery, chemotherapy, palliative care, or a combination of these. Nursing interventions after pelvic surgery to remove the tumor are similar to those after other abdominal surgeries. If ovarian cancer occurs in a young woman and the tumor is unilateral, it is removed. Childbearing, if desired, is encouraged in the near future. After childbirth, surgical reexploration may be performed, and the remaining ovary may be removed. If both ovaries are involved, bilateral oophorectomy is performed and chemotherapy follows.

Patients with advanced ovarian cancer may develop ascites and pleural effusion. Nursing care may include administering IV fluids prescribed to alleviate fluid and electrolyte imbalances, administering parenteral nutrition to provide adequate nutrition, providing postoperative care after intestinal bypass

to alleviate any obstruction, controlling pain, and managing drainage tubes. Comfort measures for women with ascites may include providing small frequent meals, decreasing fluid intake, administering diuretic agents, and providing rest. Patients with pleural effusion may experience shortness of breath, hypoxia, pleuritic chest pain, and cough. Thoracentesis is usually performed to relieve these symptoms. The patient with ovarian cancer often has complex needs and benefits from the assistance and support of an oncology clinical nurse specialist.

Hysterectomy

Hysterectomy is the surgical removal of the uterus to treat cancer, dysfunctional uterine bleeding, endometriosis, nonmalignant growths, persistent pain, pelvic relaxation and prolapse, and previous injury to the uterus. Hysterectomies have been steadily declining over the last decade as the number of other therapeutic options (i.e., laser therapy, endometrial ablation, UAE, and medications to shrink fibroid tumors) has increased (Wright, Herzog, Tsui, et al., 2013). Despite the decline in hysterectomies, it is still the most common gynecologic procedure affecting one in nine women in their lifetime; 90% of all hysterectomies are for benign causes (Clark-Pearson & Geller, 2013).

A total hysterectomy involves removal of the uterus and the cervix. Hysterectomy can be supracervical or subtotal, in which the uterus is removed but the cervix is spared. Radical hysterectomy involves removal of the uterus as well as the surrounding tissue, including the upper third of the vagina and pelvic lymph nodes. The procedure can be performed through the vagina, through an abdominal incision, or laparoscopically (in which the uterus is removed in sections through small incisions using a laparoscope). Malignant conditions usually require a total abdominal hysterectomy and bilateral salpingo-oophorectomy.

With advanced cancerwith extensive local spread pelvic exentration may be performed.Pelvic exentration is thesurgical procedure which involves removal of all the pelvic organs are removed including the genitourinary organs as well as rectum. Patients undergoing Pelvic exentration are at risk of pulmonary embolism (Grimes & Stattron, 2021). Patient may need Urinary or fecal diversion procedure. With advancement in diagnostic and preventice techniques pelvic exentration is rarely performed nowadays.

A laparoscopically assisted approach can also be used for vaginal hysterectomy. This procedure is performed as a short-stay procedure or ambulatory surgery in patients who are carefully selected. Robot-assisted hysterectomies are performed in more than 20% of cases, with similar outcomes compared to laparoscopic and vaginal methods at a higher cost (Ridgeway & Falcone, 2014).

Preoperative Management

Patients are advised to discontinue anticoagulant medications, NSAIDs such as aspirin, and vitamin E prior to surgery to reduce the risk of bleeding. Pregnancy is ruled out on the day of surgery. Prophylactic antibiotic agents may be given prior to surgery and discontinued the next day. Prevention of thromboembolic events is critical, and methods depend on the risk profile of the patient.

Postoperative Management

The principles of general postoperative care for abdominal surgery apply. Major risks are infection and hemorrhage. In addition, because the surgical site is close to the bladder, voiding problems may occur, particularly after a vaginal hysterectomy. Edema or nerve trauma may cause temporary loss of bladder tone (bladder atony), and an indwelling catheter may be inserted.

NURSING PROCESS

The Patient Undergoing a Hysterectomy

Assessment

The health history and the physical and pelvic examination are completed, and laboratory tests are performed. Additional assessment data include the patient's psychosocial responses, because the need for a hysterectomy may elicit strong emotional reactions. If the hysterectomy is performed to remove a malignant tumor, anxiety related to fear of cancer and its consequences adds to the stress of the patient and her family. Women who have had a hysterectomy may be at risk for psychological and physical symptoms. Alternatively, women may note improved physical and mental health after hysterectomy as troublesome symptoms may be alleviated.

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Anxiety related to the diagnosis of cancer, fear of pain, possible perception of loss of femininity or childbearing potential
- Disturbed body image related to altered fertility and fears about sexuality and relationships with partner and family
- Acute pain related to surgery and other adjuvant therapy
- Deficient knowledge of the perioperative aspects of hysterectomy and postoperative self-care

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Hemorrhage
- VTE
- Bladder dysfunction
- Infection

Planning and Goals

The major goals may include relief of anxiety, acceptance of loss of the uterus, absence of pain or discomfort, increased knowledge of self-care requirements, and absence of complications.

Nursing Interventions

Relieving Anxiety

Anxiety stems from several factors: unfamiliar environment; the effects of surgery on body image and reproductive ability; fear of pain and other discomfort; and, possibly, feelings of embarrassment about exposure in the perioperative period. The nurse determines what the experience means to the patient and encourages her to verbalize her concerns. Throughout the preoperative, postoperative, and recovery periods, explanations are given about physical preparations and procedures that are performed.

Patient education addresses the outcomes of surgery, possible feelings of loss, and options for management of any symptoms that occur. Women vary in their preferences for

information and participation in decision making, including choice of treatment options, accurate and useful information at the appropriate time, support from their health care providers, and access to professional and lay support systems.

Improving Body Image

The patient may have strong emotional reactions to having a hysterectomy and personal feelings related to the diagnosis, views of significant others who may be involved (family, partner), religious beliefs, and fears about prognosis. Concerns such as the inability to have children and the effect on femininity may surface, as may questions about the effects of surgery on sexual relationships, function, and satisfaction. The patient needs reassurance that she will still have a vagina and that she can experience sexual activity after temporary postoperative abstinence while tissues heal. Information that sexual satisfaction and orgasm arise from clitoral stimulation rather than from the uterus reassures many women. Most women note some change in sexual feelings after hysterectomy, but they vary in intensity. In some cases, the vagina is shortened by surgery, and this may affect sensitivity or comfort.

When hormonal balance is upset, as often occurs with reproductive system disorders, the patient may experience depressed mood and heightened emotional sensitivity to people and situations. The nurse needs to approach and evaluate each patient individually in light of these factors. A nurse who exhibits interest, concern, and willingness to listen to the patient's fears will help the patient progress through the surgical experience.

Relieving Pain

Postoperative pain and discomfort are common. Therefore, the nurse assesses the intensity of the patient's pain and assists the patient with analgesia as prescribed. If the patient has abdominal distention or flatus, a rectal tube and application of heat to the abdomen may be prescribed. When abdominal auscultation reveals return of bowel sounds and peristalsis, additional fluids and a soft diet are permitted. Early ambulation facilitates the return of normal peristalsis.

Monitoring and Managing Potential Complications

Hemorrhage. Vaginal bleeding and hemorrhage may occur after hysterectomy. To detect these complications early, the nurse counts the perineal pads used or checks the incision site, assesses the extent of saturation with blood, and monitors vital signs. Abdominal dressings are monitored for drainage if an abdominal surgical approach has been used. In preparation for hospital discharge, the nurse gives prescribed guidelines for activity restrictions to promote healing and to prevent postoperative bleeding. Because many women may go home the day of surgery or within a day or two, they are instructed to contact the nurse or surgeon if bleeding is beyond what is expected, which should be minimal.

Venous Thromboembolism. Because of positioning during surgery, postoperative edema, and decreased activity postoperatively, the patient is at risk for DVT and PE. To minimize the risk, antiembolism stockings are applied. In addition, the patient is encouraged and assisted to change positions frequently, although pressure under the knees is avoided, and to exercise her legs and feet while in bed. The nurse helps the patient ambulate early in the postoperative period. The nurse also assesses for DVT (leg pain, redness, warmth, edema) and PE (chest pain, tachycardia, dyspnea). If the patient is being discharged home soon after surgery, she is instructed to avoid prolonged sitting in a chair with pressure at the knees, sitting with crossed legs, and inactivity. Furthermore, she is instructed to contact her primary provider if symptoms of DVT or PE occur.

Bladder Dysfunction. Because of possible difficulty in voiding postoperatively, occasionally an indwelling catheter may be inserted before or during surgery and is left in place in the immediate postoperative period. If a catheter is in place, it is usually removed shortly after the patient begins to ambulate. After the catheter is removed, urinary output is monitored; additionally, the abdomen is assessed for distention. If the patient does not void within a prescribed time, measures are initiated to encourage voiding (e.g., assisting the patient to the bathroom, pouring warm water over the perineum). If the patient cannot void, catheterization may be necessary. On rare occasions, the patient may be discharged home with the catheter in place and is instructed in its management.

Promoting Home, Community-Based, and Transitional Care

Educating Patients about Self-Care. The information provided to the patient is tailored to her needs. She must know what limitations or restrictions, if any, to expect. She is instructed to check the surgical incision daily and to contact her primary provider if redness or purulent drainage or discharge occurs. She is informed that her periods are now over but that she may have a slightly bloody discharge for a few days; if bleeding recurs after this time, it should be reported immediately. The patient is instructed about the importance of an adequate oral intake and of maintaining bowel and urinary tract function. The patient is informed that she is likely to recover quickly but that postoperative fatigue is not unusual.

The patient should resume activities gradually. This does not mean sitting for long periods, because doing so may cause blood to pool in the pelvis, increasing the risk of VTE. The nurse explains that showers are preferable to tub baths to reduce the possibility of infection and to avoid the dangers of injury that may occur when getting in and out of the bathtub. The patient is instructed to avoid straining, lifting, having sexual intercourse, or driving until permitted. Vaginal discharge, foul odor, excessive bleeding, any leg redness or pain, or an elevated temperature should be reported, and the nurse reinforces education regarding activities and restrictions.

Continuing and Transitional Care. Follow-up telephone contact provides the nurse with the opportunity to determine whether the patient is recovering without problems and to answer any questions that may have arisen. The patient is reminded about postoperative follow-up appointments. If the patient's ovaries were removed and she finds vasomotor symptoms troublesome, hormone therapy may be considered at a low dose for a short amount of time. The patient is reminded to discuss risks and benefits of hormone therapy and alternative therapies with her primary provider and gynecologic care provider. Decisions about use of hormone therapy need to be made individually in consultation with these providers.

Evaluation

Expected patient outcomes may include:

1. Experiences decreased anxiety
2. Has improved body image
   a. Discusses changes resulting from surgery with her partner
   b. Verbalizes understanding of her disorder and the treatment plan

c. Displays minimal depression or anxiety
3. Experiences minimal pain and discomfort
   a. Reports relief of abdominal pain and discomfort
   b. Ambulates without pain
4. Verbalizes knowledge and understanding of self-care
   a. Practices deep-breathing, turning, and leg exercises as instructed
   b. Increases activity and ambulation daily
   c. Reports adequate fluid intake and adequate urinary output
   d. Identifies reportable symptoms
   e. Schedules and keeps follow-up appointments
5. Absence of complications
   a. Has minimal vaginal bleeding and exhibits normal vital signs
   b. Ambulates early
   c. Notes no chest or calf pain and no redness, tenderness, or swelling in the extremities
   d. Reports no urinary problems or abdominal distention

Radiation Therapy

Radiation may be used in the treatment of cervical, uterine, and less frequently in ovarian cancers either alone or in combination with surgery and chemotherapy. Several approaches are used to deliver radiation to the female reproductive system: external radiation, intraoperative radiation therapy (IORT), and internal (intracavitary) irradiation or brachytherapy (Halperin, Wazer, Perez, et al. 2013). The cervix and uterus can serve as a receptacle for radioactive sources for internal radiation therapy.

Methods of Radiation Therapy

External Radiation Therapy

This method of delivering radiation destroys cancerous cells at the skin surface or deeper in the body. Other methods of delivering radiation therapy are more commonly used to treat cancer of the female reproductive system than this method.

Intraoperative Radiation Therapy

IORT allows radiation to be applied directly to the affected area during surgery. An electron beam is directed at the disease site. This direct-view irradiation may be used when para-aortic nodes are involved or for unresectable (inoperable) or partially resectable neoplasms. Benefits include accurate beam direction (which precisely limits the radiation to the tumor) and the ability during treatment to block sensitive organs from radiation. IORT is usually combined with external-beam irradiation pre- or postoperatively.

Internal (Intracavitary) Irradiation

After the patient receives an anesthetic agent and an examination, specially prepared applicators are inserted into the endometrial cavity and vagina. These devices are not loaded with radioactive material until the patient returns to her room. X-rays are obtained to verify the precise relationship of the applicator to the normal pelvic anatomy and to the tumor. When this step is completed, the radiation oncologist loads the applicators with predetermined amounts of radioactive material. This procedure, called *afterloading*, allows for precise control of the radiation exposure received by the patient, with minimal exposure of physicians, nurses, and other health care personnel. A patient undergoing internal radiation treatment remains isolated in a private room until the application is completed. Adjacent rooms may need to be evacuated and a lead shield placed at the doorway to the patient's room.

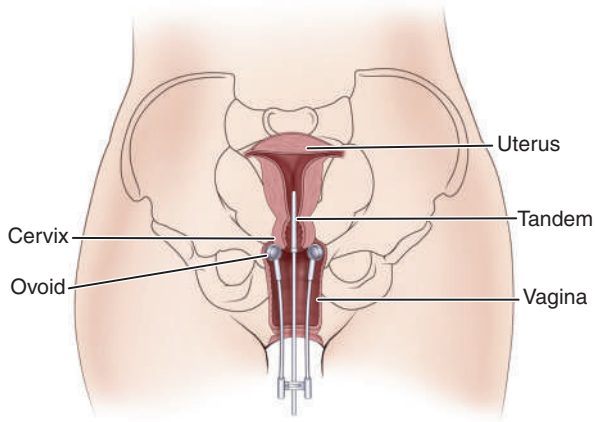


Figure 58-18 • Placement of tandem and ovoids for internal radiation therapy.

Of the various applicators developed for intracavitary treatment, some are inserted into the endometrial cavity and endocervical canal as multiple small irradiators (e.g., Heyman capsules). Others consist of a central tube (a tandem or intrauterine "stem") placed through the dilated endocervical canal into the uterine cavity, which remains in a fixed relationship with the irradiators placed in the upper vagina on each side of the cervix (vaginal ovoids) (see Fig. 58-18).

When the applicator is inserted, an indwelling urinary catheter is also inserted. Vaginal packing is inserted to keep the applicator in place and to keep other organs, such as the bladder and rectum, as far from the radioactive source as possible. The objective of the internal treatment is to maintain the distribution of internal radiation at a fixed dosage throughout the application, which may last 24 to 72 hours, depending on dose calculations made by the radiation physicist.

Automated high-dose rate intracavitary brachytherapy systems have been developed that allow outpatient radiation therapy. Treatment time is shorter, thereby decreasing patient discomfort. Staff exposure to radiation is also avoided. Isotopes of radium and cesium are used for intracavitary irradiation.

Nursing Considerations for Radiation Safety

Special precautions for the safety of the patient and the nurse are important considerations when the patient is receiving radiation therapy. The radiation safety department will identify specific safety precautions to those people who will be in contact with the patient, including health care providers and family. Nursing concerns include providing the patient with emotional support and physical comfort. Further details about nursing management are provided in the earlier part of this chapter.

Atomic Energy Regulatory Board (AERB) Norms and Radiation Safety

The cancer care centers intending to start a radiation therapy unit need to obtain the license to run the unit by adhering to the guidelines before installation as prescribed by the AERB. In the radiation therapy unit, the hazardous radiation source materials are used. Any unintentional exposure during therapy or while handling by health care professionals leads to cancer. The installation of the linear accelerator or brachytherapy unit

and usage of radiation source-sealed or unsealed method of handling are clearly given by the AERB. The radiation source cannot be exposed to the environment even for seconds. Sealing is a method of containment of radiation activity within the lead coverings or radiation-impermeable devices.

The licensed health care facility has to adhere to the norms of construction of buildings. Before commissioning the teletherapy or brachytherapy units, etc., license of the AERB is mandatory. The facility has to house all the diagnostic and treatment facilities in one area where the public movement is minimum. The facility has to be built following all radiation safety norms in terms of thickness of the walls, ceiling, floor, etc. The straight entry into the radiation facility can possibly lead to unintentional radiation exposure to all passersby. The radiotherapy unit entrance needs to be accessible after crossing more than one or two turns in the corridors.

The ventilation, lighting, and air conditioning should be adequate. The doors of both the teletherapy and brachytherapy treatment rooms with remote afterloading need to have a proper door lock with warning light at the entrance to avert unintended entry of people into the treatment room. The light should glow in green while the device is off, yellow while the beam is on, and red while the radiation device is in transition.

A radiation zone monitor needs to be fixed at the entrance of the radiation facility. A warning message about entry restriction in different languages with radiation symbol needs to be fixed near the entrance of radiation unit.

The radiation source and the device should be handled by those licensed to do so. Maintenance of the devices also needs to be carried out only by those licensed to do it.

In the eventuality of any natural disaster such as flood or fire, appropriate safety measures need to be taken. The radiation therapy unit must always be prepared for emergency. At all times, the control room near the teletherapy unit must be ready with necessary devices and radiation monitoring instruments. All health care workers employed shall use the personal protective devices such as lead jacket and gloves while handling the source. Precautions must be taken to ensure that the radiation dose exposure is within acceptable limits.

All those employed in the radiotherapy unit shall wear the dosimeter badge and periodic evaluation is done for ensuring that safe limits are not exceeded. Pregnant women and children younger than 18 years shall not be allowed to enter the facility. The occupational exposure of radiation is expected not to exceed 20 mSv/year on an average dose for 5 years. In any single year, the maximum limit for exposure radiation is 30 mSv. All employees' records of annual exposure need to be maintained regularly. If anyone is found to have an exposure in excess of that recommended, he or she may be temporarily relieved from the area of exposure or may be given leave with pay.

Preparation, storage, and disposal of the radioactive source shall be done by competent personnel following the protocols with minimal exposure to self and the others. Post-brachytherapy, the linen, equipment, and other wastes generated from the facility have to be monitored for any contamination or loss of radiation source.

In case of teletherapy, the software utilized for control panel need to be periodically checked, updated, and monitored.

Safety Alerts for Nurses Working in Radiation Therapy Unit

Nurses working with patients receiving radiation need to wear the dosimeter. Wear personnel protective equipment. When handling patients with brachytherapy, ensure that the radiation source is retracted and the green light is on.

Radiation exposure can be minimized by minimizing the time spent near the source/patient and maximizing the distance between the source and self and shielding.

Organize all care activities and complete them at one stretch instead of interrupting the radiation treatment. This will help in reducing the radiation exposure.

Educate and follow the protocol in collecting the used materials, instruments, linen, and other things from the brachytherapy unit. It is considered as hazardous. Patients treated with systemic radiation have to be isolated and treated in a radiation-proof chamber or room. The feces and urine may contain the radioactive substance and should be handled with personal protective devices. Do not eat, drink, or apply cosmetics while working in the radiation therapy unit to prevent contamination. Avoid spillage of unprotected radiation sources.

Place laundry in a linen bag and save until surveyed and released by the radiation oncology or health physics department. Housekeeping staff may not enter the room unless escorted by a nurse. Only essential cleaning may be carried out.

Cancer Survivorship

Advances in cancer screening, treatment, and management of complications have contributed to a lengthened survival period for many, with long-term survival becoming possible for many patients. *Cancer survivorship* has been defined as the period from cancer diagnosis through the remaining years of life and focuses on the health and life of a person beyond diagnostic and treatment phases. Although individuals vary and many types of cancers and treatments exist, the acute, long-term, and late effects of cancer and its treatment may have multiple long-term physical, cognitive, psychological, social, and financial consequences that can impact activities of daily living, ultimately affecting quality of life (Given, 2015).

Survivorship care is often based on expert opinion and experience rather than on evidence-based practices. Knowledge regarding survivorship concerns continues to evolve. The Institute of Medicine has identified four components of survivorship care, the period that follows primary treatment for cancer and lasts until end of life. In addition to a summary of prior diagnosis and treatment, survivorship care includes monitoring and treatment for late effects related to disease and prior treatments, physical and vocational rehabilitation, psychosocial support and counseling as necessary, and surveillance and screening for new and recurrent cancer (Hewitt, Greenfield, & Stovall, 2006) (see Table 58-20). Advocacy organizations across the country have recommended that a survivorship care plan be provided to all patients with cancer and their primary provider at the completion of treatment. The survivorship care plan includes a summary of cancer diagnosis and treatment and recommendations for follow-up and care, including approaches to treat symptoms, rehabilitative needs, monitoring for late effects, and surveillance and screening for new and recurrent cancer. Referrals for specific services such as lymphedema therapy, chronic pain management, and genetic counseling are also provided. Nurses assist in the development of the survivorship care plan and provide education and care for cancer survivors. Nurses, other health care providers, public health professionals, and patient advocates design and conduct research to identify needs of cancer survivors and evidence-based approaches to care.

TABLE 58-20 Components of Survivorship Care

Component	Examples of Care
Prevention and detection of new and recurrent cancer	• Mammography (per ACS guidelines) • Papanicolaou (Pap) smears (per ACS guidelines) • Smoking cessation programs • Nutrition counseling
Surveillance for cancer spread, recurrence, or second cancers	• Colonoscopy post colon cancer • Mammography post breast cancer • Liver function tests post colon cancer • Prostate-specific antigen post prostate cancer
Intervention for consequences of cancer and its treatments	• Lymphedema therapy • Pain management • Enterostomal therapy • Fertility care • Psychosocial support or counseling • Reconstructive surgery
Coordination between specialists and primary providers to meet health needs	• Care for comorbidities (e.g., diabetes) • Influenza vaccination • Bone densitometry • Monitoring for chemotherapy induced cardiotoxicity

ACS, American Cancer Society.

Adapted from Hewitt, M., Greenfield, S., & Stovall, E. (Eds.). (2006). From cancer patient to cancer survivor. Washington, DC: Institute of Medicine and National Research Council, National Academies Press. Components of survivorship care provided by the Institute of Medicine report on cancer survivorship.

Providing Care to the Patient with Advanced Cancer

Providing Care in Oncologic Emergencies

Table 58-21 discusses selected nursing and medical care of oncologic emergencies.

As a result of advances in all aspects of cancer care, it is more common that individuals are living with cancer that has advanced beyond the original site of development to regional or distant sites. Patients with advanced cancer are likely to experience many of the problems described previously, although more often and to a greater degree. Symptoms of pain, anorexia, weight loss, CACS, fatigue, and impaired functional status and mobility make patients more susceptible to depressive symptoms, skin breakdown, fluid and electrolyte imbalances, and infection.

Treatment for the patient with advanced cancer is likely to be palliative rather than curative, with an emphasis on prevention and appropriate management of pain. The use of long-acting analgesic agents at set intervals, rather than on an "as needed" basis, is recommended in addressing pain management. Working with the patient and family, as well as with other health care providers, to manage pain is essential to increase the patient's comfort and offer some sense of control. Other medications (e.g., sedatives, tranquilizers, muscle relaxants, antiemetics) are added to assist in palliating additional symptoms and promoting quality of life.

If the patient is a candidate for radiation therapy or surgical interventions to relieve pain or other symptoms, the potential benefits and risks of these procedures (e.g., percutaneous nerve block, cordotomy) are explained to the patient and family.

TABLE 58-21 Oncologic Emergencies: Manifestations and Management

Emergency	Clinical Manifestations and Diagnostic Findings	Management
Superior Vena Cava Syndrome (SVCS) Compression or invasion of the superior vena cava by tumor; enlarged lymph nodes; intraluminal thrombus that obstructs venous circulation; or drainage of the head, neck, arms, and thorax. Most often associated with lung cancer, SVCS is also associated with lymphoma, thymoma, and testicular cancers and mediastinal metastases from breast cancer. If untreated, SVCS may lead to cerebral anoxia (because not enough oxygen reaches the brain), laryngeal edema, bronchial obstruction, and death.	**Clinical** Gradually or suddenly impaired venous drainage giving rise to: • Progressive shortness of breath (dyspnea), cough, hoarseness, chest pain, and facial swelling • Edema of the neck, arms, hands, and thorax and reported sensation of skin tightness, difficulty swallowing, and stridor • Possibly engorged and distended jugular, temporal, and arm veins • Dilated thoracic vessels causing prominent venous patterns on the chest wall • Increased intracranial pressure, associated visual disturbances, headache, and altered mental status **Diagnostic** Diagnosis is confirmed by: • Clinical findings • Chest x-ray • Thoracic computed tomography (CT) scan • Thoracic magnetic resonance imaging (MRI) • Venogram if intraluminal thrombosis is suspected	**Medical** • Radiation therapy to shrink tumor or enlarged lymph nodes and relieve symptoms • Chemotherapy for sensitive cancers (e.g., lymphoma, small cell lung cancer) or when the mediastinum has been irradiated to maximum tolerance • Anticoagulant or thrombolytic therapy for central venous catheter related intraluminal thrombosis • Percutaneously placed intravascular stents may be priority consideration rather than surgery unless symptoms are rapidly progressing. • Supportive measures such as oxygen therapy, corticosteroids, and diuretics (in cases of fluid overload) **Nursing** • Identify patients at risk for SVCS. • Provide patient education regarding signs and symptoms to report • Monitor and report clinical manifestations of SVCS. • Monitor cardiopulmonary and neurologic status. • Avoid upper extremity venipuncture and blood pressure measurement; instruct patient to avoid tight or restrictive clothing and jewelry on fingers, wrist, and neck.

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		• Facilitate breathing and drainage from upper portion of body by instructing patient to maintain some elevation of head and upper body with semi-Fowler position; avoid completely supine or prone position (this helps to promote comfort and reduce anxiety associated with dependent and progressive edema). • Promote energy conservation to minimize shortness of breath. • Monitor the patient's fluid volume status; administer fluids cautiously to minimize edema. • Assess for thoracic radiation-related problems such as mucositis with resultant dysphagia (difficulty swallowing) and esophagitis. • Monitor for chemotherapy-related problems, such as myelosuppression. • Provide postoperative care as appropriate.
Spinal Cord Compression Most commonly caused by compression of the cord and its nerve roots by a metastatic paravertebral tumor that extends into the epidural space; vertebral bone metastasis leading to bone collapse and displacement impinging on the spinal cord or nerve roots; and less commonly, primary malignancy of the cord. May potentially lead to significant and permanent neurologic impairment associated with multiple physical, psychosocial consequences. Most often associated with cancers that metastasize to the bone such as breast, lung, and prostate cancers and lymphoma. Also seen in nasopharyngeal cancer and multiple myeloma. About 70% of compressions occur at the thoracic level, 20% in the lumbosacral level, and 10% in the cervical and sacral regions. The prognosis depends on the severity and rapidity of onset.	**Clinical** • Local inflammation, edema, venous stasis, and impaired blood supply to nerve tissues • Local or radicular back or neck pain along the dermatomal areas innervated by the affected nerve root (e.g., thoracic radicular pain extends in a band around the chest or abdomen) • Pain exacerbated by movement, supine recumbent position, coughing, sneezing, or the Valsalva maneuver • Neurologic dysfunction and related motor and sensory deficits (numbness, tingling, feelings of coldness in the affected area, inability to detect vibration, loss of positional sense) • Motor loss ranging from subtle weakness to flaccid paralysis • Bladder and/or bowel dysfunction depending on level of compression (above S2, overflow incontinence; from S3 to S5, flaccid sphincter tone and bowel incontinence). **Diagnostic** • Percussion tenderness at the level of compression • Abnormal reflexes • Sensory and motor abnormalities • MRI is a preferred diagnostic tool; may also utilize x-rays, bone scans, and CT scan.	**Medical** • Radiation therapy to reduce tumor size and halt progression; corticosteroid therapy to decrease inflammation and swelling at the compression site • Surgery to debulk tumor and stabilize the spine if symptoms progress despite radiation therapy or if vertebral fracture or bone fragments lead to additional nerve damage; surgery is also an option when the tumor is not radiosensitive or is located in an area that was previously irradiated. • Minimally invasive surgical procedures, referred to as vertebral augmentation, may be used for patients with vertebral fractures to attain stability of the bone, prevent nerve compression, and decrease pain. Procedures include: • Vertebroplasty: involves percutaneous injection of polymethyl methacrylate (PMMA), a bone cement filler, into the vertebral body • Kyphoplasty: a balloon is inserted into the damaged vertebral body and then inflated to create a cavity within the bone that can be filled with bone cement. The balloon helps to compress the fracture fragments together as the cavity is created. • Radiofrequency vertebral augmentation: similar to kyphoplasty; instead of the balloon, a small navigational canula is inserted into the vertebra to create small pathways for cement. The cement is heated with radiofrequency to create an ultra high viscosity that is thought to promote bone stability • Chemotherapy as adjuvant to other local therapies for patients with chemosensitive cancers such as lymphoma or small cell lung cancer • *Note:* Despite treatment, patients with poor neurologic function before treatment are less likely to regain complete motor and sensory function; patients who develop complete paralysis usually do not regain all neurologic function. **Nursing** • Perform ongoing assessment of neurologic function to identify existing and progressing dysfunction. • Control pain with pharmacologic and nonpharmacologic measures. • Prevent complications of immobility resulting from pain and decreased function (e.g., skin breakdown, urinary stasis, thrombophlebitis, decreased clearance of pulmonary secretions).

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		• Maintain muscle tone by assisting with range-of-motion exercises in collaboration with physical and occupational therapists; patients with unstable vertebral fractures do not initiate physical therapy until spine stabilization procedures have been completed. • Institute intermittent urinary catheterization and bowel training programs for patients with bladder or bowel dysfunction. • Provide encouragement and support to patient and family coping with pain and altered functioning, lifestyle, roles, and independence. • Institute appropriate referrals for home care and physical and occupational therapy.
Hypercalcemia Hypercalcemia is a potentially life-threatening metabolic abnormality resulting when the calcium released from the bones is more than the kidneys can excrete or the bones can reabsorb. • It may result from production of cytokines, hormonal substances, and growth factors by cancer cells, or by the body in response to substances produced by cancer cells, which lead to bone breakdown and calcium release. • Most commonly seen in breast, lung, and renal cancers; myeloma; and some types of leukemia	**Clinical** Fatigue, weakness, confusion, decreased level of responsiveness, hyporeflexia, nausea, vomiting, constipation, ileus, polyuria (excessive urination), polydipsia (excessive thirst), dehydration, and dysrhythmias **Diagnostic** Total serum calcium level >10.5 mg/dL (2.74 mmol/L) Ionized serum calcium >1.29 mmol/L	**Medical** • Identify patients at risk for hypercalcemia and assess for signs and symptoms of hypercalcemia. • Educate patient and family; prevention and early detection can prevent fatality. • Educate at-risk patients to recognize and report signs and symptoms of hypercalcemia. • Provide patient and family education regarding: • Need to consume 2–4 L of fluid daily unless contraindicated by existing renal or cardiac disease • Use of dietary and pharmacologic interventions such as stool softeners and laxatives for constipation • Maintenance of nutritional intake without restricting normal calcium intake • Antiemetic therapy for nausea and vomiting • Promotion of mobility and emphasis on importance in preventing demineralization and breakdown of bones • Safety precautions for patients with impaired mental and mobility status
Tumor Lysis Syndrome (TLS) Potentially fatal complication that occurs spontaneously or more commonly following radiation, biotherapy, or chemotherapy-induced cell destruction of large or rapidly growing cancers such as leukemia, lymphoma, and small cell lung cancer. The release of tumor intracellular contents (nuclei acids, electrolytes, and debris) leads to rapidly induced electrolyte imbalances—hyperkalemia, hyperphosphatemia (leading to hypocalemia), and hyperuricemia—that can have life-threatening end-organ effects on the myocardium, kidneys, and central nervous system	**Clinical** Clinical manifestations depend on the extent of metabolic abnormalities. Clinical TLS is diagnosed when ≥1 of 3 conditions arise either 3 days prior to or 7 days after cytotoxic cancer therapy: acute kidney injury (defined as a rise in creatinine to ≥1.5 times the upper limit of normal that is not attributable to medications), dysrhythmias (including sudden cardiac death), and seizures. • *Neurologic:* Fatigue, weakness, memory loss, altered mental status, muscle cramps, tetany, paresthesias (numbness and tingling), seizures • *Cardiac:* Elevated blood pressure, shortened QT complexes, widened QRS waves, altered T waves, dysrhythmias, cardiac arrest • GI: Anorexia, nausea, vomiting, abdominal cramps, diarrhea, increased bowel sounds • Renal: Flank pain, oliguria, anuria, kidney injury, acidic urine pH • Other: Gout, malaise, pruritis **Diagnostic** • Electrolyte imbalances identified by serum electrolyte measurement and urinalysis (see Chapter 7); electrocardiogram to detect cardiac dysrhythmias	**Medical** • To prevent kidney injury and restore electrolyte balance, aggressive fluid hydration is initiated 24–48 hours before and after the initiation of cytotoxic therapy to increase urine volume and eliminate uric acid and electrolytes; urine is alkalinized by adding sodium bicarbonate to IV fluid to maintain a urine pH of 7–7.5; this prevents kidney injury secondary to uric acid precipitation in the kidneys. • Diuresis with a loop diuretic or osmotic diuretic if urine output is not sufficient • Allopurinol (Zyloprim) therapy to inhibit the conversion of nucleic acids to uric acid; rasburicase (Elitek) may be used to convert already formed uric acid to allantoin, which is highly water soluble and eliminated in urine. • Administration of a cation-exchange resin, such as sodium polystyrene sulfonate (Kayexalate), to treat hyperkalemia by binding and eliminating potassium through the bowel • Administration of IV sodium bicarbonate, hypertonic dextrose, and regular insulin temporarily shifts potassium into cells and lowers serum potassium levels if a rapid decrease in potassium is necessary. • Administration of phosphate-binding gels, such as aluminum hydroxide, to treat hyperphosphatemia by promoting phosphate excretion in the feces

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	• Hemodialysis when patients are unresponsive to the standard approaches for managing uric acid and electrolyte abnormalities. • Identify at-risk patients. • Institute essential preventive measures (e.g., fluid hydration, medications) as prescribed. • Assess patient for signs and symptoms of electrolyte imbalances. • Assess urine pH to confirm alkalization. • Monitor serum electrolyte and uric acid levels for evidence of fluid volume overload secondary to aggressive hydration. • Instruct patients to monitor for and report symptoms indicating electrolyte disturbances.

MRI, magnetic resonance imaging; CT, computed tomography.

Adapted from Baehring, Y. (2015). Oncologic emergencies: Spinal cord compression. In V. T. DeVita, T. S. Lawrence, & S. A. Rosenberg (Eds.). Cancer: Principles & practice of oncology. Philadelphia, PA: Lippincott Williams & Wilkins; Wallace, A., Robinson, C., Myer, J., et al. (2015). The metastatic spine disease multidisciplinary working group algorithms. The Oncologist, 20 (9), 1—11; Wang, L., Jian, Y., Yang, G., et al. (2015). Management of tumor lysis syndrome in patients with multiple myeloma during bortezomib treatment. Clinical Journal of Oncology Nursing. 19(1), E4–E7; Yahalom, J. (2015). Oncologic emergencies: Superior vena cava syndrome. In V. T. DeVita, T. S. Lawrence, & S. A. Rosenberg (Eds.). Cancer: Principles & Practice of Oncology. Philadelphia, PA: Lippincott Williams & Wilkins.

Measures are taken to prevent complications that result from altered sensation, immobility, and changes in bowel and bladder function.

Weakness, altered mobility, fatigue, and inactivity typically increase with advanced cancer as a result of the disease, treatment, inadequate nutritional intake, or dyspnea. The nurse works with the patient and family to identify realistic goals and promote comfort. Measures include use of energy conservation methods to accomplish tasks and activities that the patient values most.

Efforts are made to provide the patient with as much control and independence as desired but with assurance that support and assistance are available when needed. In addition, health care teams work with the patient and family to ascertain and comply with the patient's wishes about treatment methods and care as the terminal phase of illness and death approach.

Hospice

The needs of patients with end-stage illness are best met by a comprehensive interdisciplinary specialty program that focuses on quality of life; palliation of symptoms; and provision of physical, psychosocial, and spiritual support for patients and families when cure and control of the disease are no longer possible. The concept of hospice best addresses these needs.

Hospice care is often delivered through coordination of specialty services provided by hospitals, home care programs, and the community. Patients need to be referred to hospice services in a timely fashion so that complex patient and family needs can be addressed. (See Chapter 59 for detailed discussion of end-of-life care.)

CRITICAL THINKING EXERCISES

1. A 63-year-old man previously treated for stage III prostate cancer with HDR brachytherapy and androgen deprivation therapy returns to the cancer center for a follow-up visit. While you are assessing his vital signs, he tells you that he has been having back pain for the last 3 weeks that he attributes to sleeping on an old mattress. What are the priorities to include in your nursing assessment of this patient? Identify the diagnostic procedures that you anticipate will be required to further evaluate this patient's back pain. What are your priorities for care of this patient?
2. An 80-year-old woman, who lives alone, was just recently diagnosed with stage IV colon cancer. She is being discharged from the hospital following a palliative colon resection. What will be the focus of educating this patient for self-care? Describe at least three age-related implications that will be important to consider. What type of referrals might be appropriate for this woman?
3. You are caring for a 32-year-old woman who is a breast cancer survivor. The patient takes tamoxifen 20 mg orally once daily and this will continue for the next 5 years. Are there any preventive measures that should be considered to address survivorship needs? What is the evidence for these interventions and education that you identified? How strong is that evidence, and what criteria did you use to assess the strength of that evidence?
4. A 43-year-old lady Mrs. J is diagnosed with cancer in the cervix and she is subjected to radical hysterectomy surgery followed by pelvic irradiation using teletherapy protocols. What are the priorities of care for Mrs. J? What are the evidence-based interventions you may plan for her?

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

Acharyya, S., Matrisian, L., Welch, D. R., et al. (2015). Invasion and metastasis. In J. Mendelsohn, P. M. Howley, M. A. Israel, et al. (Eds.). The molecular basis of cancer. Philadelphia, PA: Elsevier-Saunders.

Alt-Epping, B., & Nauck, F. (Eds.). (2015). Palliative care in oncology. Berlin: Springer.

Baehring, Y. (2015). Oncologic emergencies: Spinal cord compression. In V. T. DeVita, T. S. Lawrence, & S. A. Rosenberg (Eds.). Cancer: Principles & practice of oncology. Philadelphia, PA: Lippincott Williams & Wilkins.

Barbarotta, L. M. (2015). Oncologic emergencies in critical care. In Booker, K. J. (Ed.). Critical care nursing: Monitoring and treatment for advanced nursing practice. Oxford, UK: Wiley Blackwell.

Bardia, A., & Baselga, J. (2014). Preoperative chemotherapy for operable breast cancer. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Cherny, N., & Truong, P. (2014). Brachial plexopathy in patients with breast cancer. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Chung, A., & Giuliano, A. (2014). Sentinel lymph node biopsy. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

DeNavas-Walt, C., Proctor, B. D., & Smith, J. C. (2013). Income, poverty, and health insurance coverage in the United States: 2012. Washington, DC: U.S. Government Printing Office, Report # P60–245.

Grossman, S. C., & Porth, C. M. (2014). Porth's pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Gucalp, A., Morris, P., Hudis, C., et al. (2014). Implications of obesity in breast cancer. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Harris, J., & Morrow, M. (2014). Breast-conserving therapy. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Helvie, M., & Patterson, S. (2014). Imaging analysis: Mammography. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

**Hewitt, M., Greenfield, S., & Stovall, E. (Eds.). (2006). From cancer patient to cancer survivor. Washington, DC: Institute of Medicine and National Research Council, National Academies Press.

Halperin, E. C., Wazer, D. E, Perez, C. A., et al. (Eds.). (2013). Perez and Brady's principles and practice of radiation oncology (6th ed.). Philadelphia, PA: Lippincott Williams and Wilkins.

Jochelson, M. (2014). New breast imaging techniques. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Kasper, D. L., Fauci, A. S., Hauser, S. L., et al. (Eds.). (2015). Harrison's principles of internal medicine (19th ed.). New York: McGraw Hill Education.

Kimmick, G., Hughes, K., & Muss, H. (2014). Breast cancer in older women. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Lu, Y., Clague, J., & Bernstein, L. (2015). Cancer etiology: Obesity and physical activity. In V. T. DeVita, T. S. Lawrence, & S. A. Rosenberg (Eds.). Cancer: Principles & practice of oncology. Philadelphia, PA: Lippincott Williams & Wilkins.

Maziarz, R. T., & Schubach-Slater, S. (Eds.). (2015). Blood and marrow transplant handbook: Comprehensive guide for patient care. New York: Springer.

McLaughlin, S. (2014). Lymphedema. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Meneses, K., & Walker, D. (2014). Nursing care in patient management and quality of life. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Morgan, M. A., Ten Haken, R. K., & Lawrence, T. S. (2015). Essentials of radiation therapy In V. T. DeVita, T. S. Lawrence, & S. A. Rosenberg (Eds.). Cancer: Principles & practice of oncology. Lippincott Williams & Wilkins: Philadelphia.

Morrow, M. (2014). Physical examination of the breast. In J. Harris, M. Lippman, M. Morrow, et al. (Eds.). Diseases of the breast (5th ed.). Philadelphia, PA: Wolters Kluwer.

Nguyen, D. M., Summers, R. M., & Finkelstein, S. E. (2015). Cancer diagnosis: Respiratory tract. In V. T. DeVita, T. S. Lawrence, & S. A. Rosenberg (Eds.). Cancer: Principles & practice of oncology. Philadelphia, PA: Lippincott Williams & Wilkins.

Schulmeister, L. (2014). Safe management of chemotherapy: Infusion-related complications. In M. Polovich, M. Olsen, & M. LeFebvre (Eds.). Chemotherapy and biotherapy guideline and recommendations for practice (4th ed.). Pittsburgh: Oncology Nursing Society.

Segal, B. H., Walsh, T. J., Gea-Banacloche, J. C., et al. (2015). Infections in the cancer patient. In V. T. DeVita, T. S. Lawrence, & S. A. Rosenberg (Eds.). Cancer: Principles & practice of oncology. Philadelphia, PA: Lippincott Williams & Wilkins.

U.S. Department of Health and Human Services. (2014). The health consequences of smoking-50 years of progress: A report from the Surgeon General. Atlanta, GA: Author.

Weber, J., & Kelley, J. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Yahalom, J. (2015). Oncologic emergencies: Superior vena cava syndrome. In V. T. DeVita, T. S. Lawrence, & S. A. Rosenberg (Eds.). Cancer: Principles & practice of oncology. Philadelphia, PA: Lippincott Williams & Wilkins.

Yarbo, C. H., Wujcik, D., & Gobel, B. H. (Eds.). (2013). Breast cancer. Sudbury, MA: Jones & Bartlett.

Journals and Electronic Documents

Alesi E. R., & del Fabbro, E. (2014). Opportunities for targeting the fatigue-anorexia-cachexia symptom cluster. The Cancer Journal, 20(5), 325–329.

American Cancer Society (ACS). (2014). Cancer treatment and survivorship: Facts and figures 2014–2015. Retrieved on 3/22/2016 at: www.cancer.org/acs/groups/content/@research/documents/document/acspc-042801.pdf

American Cancer Society (ACS). (2015a). Cancer facts and figures 2015. Retrieved on 2/22/2016 at: www.cancer.org/acs/groups/content/@editorial/documents/document/acspc-044552.pdf

American Cancer Society (ACS). (2015b). Menopausal hormone therapy and cancer risk. Retrieved on 3/4/2016 at: www.cancer.org/cancer/cancercauses/othercarcinogens/medicaltreatments/menopausal- hormone-replacement-therapy-and-cancer-risk

American Cancer Society (ACS). (2016a). Cancer facts and figures for African Americans 2016–2018. Retrieved on 12/01/2016 at: www.cancer.org/acs/groups/content/@editorial/documents/document/acspc-047403.pdf

American Cancer Society (ACS). (2016b). Cancer facts and figures 2016. Retrieved 12/1/16 at: www.cancer.org/acs/groups/content/@research/documents/document/acspc-047079.pdf

Bonilla, L., Ben-Aharon, I., Vidal, L., et al. (2010). Dose-dense chemotherapy in nonmetastatic breast cancer: A systematic review and meta-analysis of randomized controlled trials. Journal of the National Cancer Institute, 102(24), 1845–1854.

Braskett, M., & Cohen, M. (2014). Diagnosis and management of chemotherapy induced hypersensitivity reactions. American College of Physicians Hospitalist, Retrieved on 3/11/2016 at: www.acphospitalist.org/archives/2014/06/expert_analysis.htm.

Beck, M. (2015). Radiation safety in the management of patients undergoing radioactive iodine ablation therapy. Clinical Journal of Oncology Nursing, 19(1), 44–46.

Bender, C. M., & Thelen, B. D. (2013). Cancer and cognitive changes: The complexity of the problem. Seminars in Oncology Nursing, 29(4), 232–237.

Benito, L., Binefa, G., Lluch, T., et al. (2014). Defining the role of the nurse in population-based cancer screening programs: A literature review. Oncology Nursing Forum, 18(2), 77–83.

Bessede, E., Dubus, P., Megraud, F., et al. (2014). Helicobacter pylori infection and stem cells at the origin of gastric cancer. Oncogene, 34(20), 2547–2555.

Blix, A. (2014). Personalized medicine, genomics, and pharmacogenomics: A primer for nurses. Clinical Journal of Oncology Nursing, 18(4), 437–441.

Bozzetti, F. (2013). Nutritional support of the oncology patient. Critical Reviews in Oncology & Hematology, 87(2), 172–200.

Brittain, K., & Murphy, V. P. (2015). Sociocultural and health correlates related to colorectal cancer screening adherence among urban African Americans. Cancer Nursing, 38(2), 118–124.

Bryant, A. L., Walton, A. L., & Phillips, B. (2015). Cancer-related fatigue: Scientific progress has been made in 40 years. Clinical Journal of Oncology Nursing, 19(2), 137–139.

Caruana, I., Diaconu, I., & Dottia, G. (2014). From monoclonal antibodies to chimeric antigen receptors for the treatment of human malignancies. Seminars in Oncology, 41(5), 661–666.

Centers for Disease Control and Prevention (CDC). (2014). Basic information about gynecologic cancers. Retrieved on 11/27/2015 at: www.cdc.gov/cancer/gynecologic/basic_info/what-is-gynecologic-cancer.htm

Castells, M. C. (2015). Anaphylaxis to chemotherapy and monoclonal antibodies in anaphylaxis. Immunology and allergy clinics of North America, 35(2), 335–348.

Centers for Disease Control and Prevention (CDC). (2015). Hepatitis B FAQs for health professionals. Retrieved 3/7/16 at: www.cdc.gov/hepatitis/hbv/hbvfaq.htm#D4

Chavez-McGregor, M., Clarke, C. A., Lichtensztajn, D. Y., et al. (2016). Delayed initiation of adjuvant chemotherapy among patients with breast cancer. JAMA Oncology, 2(3), 322–329.

Chen, C. J., Hsu, W. L., Yang, H. I., et al. (2014). Epidemiology of virus infection and human cancer. Recent Results in Cancer Research, 193, 11–32.

Citrin, D. E., & Mitchell, J. B. (2014). Altering the response to radiation: Sensitizers and protectors. Seminars in Oncology, 41(6), 848–859.

Chung, T. K., Rosenthal, E. L., Magnuson, J. S., et al. (2015). Transoral robotic surgery for oropharyngeal and tongue cancer in the United States. Laryngoscope, 125(1), 140–145.

Clarke, T. C., Black, L. I., Stussman, B. J., et al. (2015). Trends in the use of complementary health approaches among adults: United States, 2002–2012. National Health Statistics Reports, 79, 1–16.

Collins, F. S., & Varmus, H., (2015). A new initiative on precision medicine. New England Journal of Medicine, 372(9), 793–795.

Corbin, K. S., Hellman, S., & Weichselbaum, R. R. (2013). Extracranial oligometastases: A subset of metastases curable with stereotactic radiotherapy. Journal of Clinical Oncology, 31(11), 1384–1390.

Cotogni, P., Barbero, C., Garrino C., et al. (2015). Peripherally inserted central catheters in non-hospitalized cancer patients: 5-year results of a prospective study. Supportive Care in Cancer, 23(2), 403–409.

Coyle, C. E., Griffie, J., & Czaplewski, L. M. (2014). Eliminating extravasation events: A multidisciplinary approach. Journal of Infusion Nursing, 37(3), 157–164.

Damsky-Dell, D., Held-Warmkessel, J., Jakubek, P., et al. (2014). Care of the open abdomen after cytoreductive surgery and hyperthermic intraperitoneal chemotherapy for peritoneal surface malignancies. Oncology Nursing Forum, 41(4), 438–441.

Datta, S., Kundu, S., Ghosh, P., et al. (2014). Correlation of oxidant status with oxidative tissue damage in patients with rheumatoid arthritis. Clinical Rheumatology, 33(11), 1557–1564.

Devi, K. U. (2009). Current status of gynaecological cancers in India. Indian Journal of Gynecologic Oncology, 20(2), 77–80.

Di Lascio, S., & Pagani, O. (2014). Oligometastatic breast cancer: A shift from palliative to potentially curative treatment? Breast Care, 9(1), 7–14.

**DuPen, A. R., DuPen, S., Hansberry, J., et al. (2000). An educational implementation of a cancer pain algorithm for ambulatory care. Pain Management Nursing, 1(4), 118.

*Eaton, L. H., Mitchell, D. H., & Doorenbos, A. Z. (2015). Evidence-based practice beliefs and behaviors of nurses providing cancer pain management: A mixed-methods approach. Oncology Nursing Forum, 42(2), 165–173.

Eilers, J., Harris, D., Henry, K., et al (2014). Evidence-based interventions for cancer treatment-related mucositis: Putting evidence into practice. Clinical Journal of Oncology Nursing, 18(6), 80–96.

Fogh, S., &Yom, S. S. (2014). Symptom management during the radiation oncology treatment course: A practical guide for the oncology clinician. Seminars in Oncology, 41(6), 764–775.

Frankel Kelvin, J. (2015) Sperm banking: Fertility preservation for male patients with cancer. Clinical Journal of Oncology Nursing, 19(1), 108–110.

Fritz, A., Percy, C., Jack, A., et al. (2013). International classification of diseases for oncology (ICD-O)–3rd edition, 1st revision. Retrieved on 2/25/2016 at: apps.who.int/iris/bitstream/10665/96612/1/9789241548496_eng.pdf?ua=1

Gibson, R. J., Keefe, D. M., Lalla, R. V., et al. (2013). Systematic review of agents for the management of gastrointestinal mucositis in cancer patients. Supportive Care in Cancer, 21(1), 313–326.

Given, B. (2015). Prevention, identification, and management of late effects through risk reduction. Seminars in Oncology Nursing, 31(1), 31–41.

Goldfarb, S., Mulhall, J., Nelson, C., et al. (2013). Sexual and reproductive health in cancer survivors. Seminars in Oncology, 40(6), 726–744.

Gonella, S., & Di Giulio, P. (2015). Delayed chemotherapy-induced nausea and vomiting in the hematology population: A review of the literature. Clinical Journal of Oncology Nursing, 19(4), 438–443.

Gonzalez, T. (2013). Chemotherapy extravasations: Prevention, identification, management and documentation. Clinical Journal of Oncology Nursing, 17(1), 61–66.

Grimes, W. R., & Stratton, M. (2021). Pelvic exentration (updated 2021, Nov 22). In StatPearls (Internet). Treasure Island, FL: StatPearls Publishing.

Herrero, R., Quint, W., Hildesheim, S., et al. (2015). Reduced prevalence of oral human papillomavirus (HPV) 4 years after bivalent HPV vaccination in a randomized clinical trial in Costa Rica. PLoS ONE, 8(7), 1–9.

Heston, A. H., Schwartz, A. L., Justice-Gardiner, H., et al. (2015). Addressing physical activity needs of survivors by developing a community-based exercise program: LIVESTRONG at the YMCA. Clinical Journal of Oncology Nursing, 19(2), 213–217.

ICMR: National Center for Disease Informatics and Research; National Cancer Registry Programme (2016). Available at http://www.ncrpindia.org/reviwed on 12/03/2018.

IMS Institute. (2014). Innovation in cancer care and implications for health systems: Global oncology trend report. Retrieved 3/7/16 at: www.imshealth.com/vgn-ext-templating/v/index.jsp?vgnextoid=f8d4df7a5e8b5410VgnVCM10000076192ca2RCRD

Jansen, C. E. (2013). Cognitive changes associated with cancer and cancer therapy: Patient assessment and education. Seminars in Oncology Nursing, 29(4), 270–279.

Kannan, R., Madden, K., & Andrews, S. (2014). Primer on immuno-oncology and immune Response. Clinical Journal of Oncology Nursing, 18(3), 311–317, 326.

Kelvin, J. F., Steed, R., & Jarrett, J. (2014). Discussing safe sexual practices during cancer treatment. Clinical Journal of Oncology Nursing, 18(4), 449–453.

Kerlikowske, K. (2015). Progress toward consensus on breast cancer screening guidelines and reducing harms. JAMA Internal Medicine, 173(12), 1970–1971.

Knobf, M. (2013). Being prepared: Essential to self-care and quality of life for the person with cancer. Clinical Journal of Oncology Nursing, 17(3), 255–261.

Kohler, B. A., Sherman, R. L., Howlader N., et al. (2015). Annual report to the nation on the status of cancer, 1975–2011. Journal of the National Cancer Institute, 107(6), 1–25.

Kuter, D. J. (2015). Managing thrombocytopenia associated with cancer chemotherapy. Oncology, 29(4), 282–294.

*Lassiter, M., & Schneider, S. M. (2015). A pilot study comparing the neutropenic diet to a non-neutropenic diet in the allogeneic hematopoietic stem cell transplantation population. Oncology Nursing Forum, 19(3), 273–278.

Lovly, C. M., Horn, L., & Pao, W. (2015). KRAS in non-small cell lung cancer (NSCLC). My cancer genome. Retrieved on 2/25/2016 at: www.mycancergenome.org/content/disease/lung-cancer/kras/

Leduc-Souville, B., Bertrand, E., & Schlatter, J. (2013). Risk management of excreta in a cancer unit. Clinical Journal of Oncology Nursing, 17(3), 248–252.

Mack, F., Ritchie, M., & Sapra, P., (2014). The next generation of antibody drug conjugates. Seminars in Oncology, 41(5), 637–652.

Lukens, N. J., Gamez, M., Hu, K., et al. (2014). Modern brachytherapy. Seminars in Oncology, 41(6), 831–847.

Mahon, S. M. (2014). Providing care for previvors: Implications for oncology nurses. Clinical Journal of Oncology Nursing, 18(1), 21–24.

Manea, P. (2014). Optimizing the management of patients with myelofibrosis. Clinical Journal of Oncology Nursing, 18(3), 330–337.

Mazanec, P., & Prince-Paul, M. (2014). Integrating palliative care into active cancer treatment. Seminars in Oncology Nursing, 30(4), 203–211.

Merriman, J. D., Von Ah, D., Miaskowski, C., et al. (2013). Proposed mechanisms for cancer and treatment-related cognitive changes. Seminars in Oncology Nursing, 29(4), 260–269.

Miceli, T, Lilleby, T., Noonan, K., et al. (2013). Autologous hematopoietic stem cell transplantation for patients with multiple myeloma: An overview for nurses in community practice. Clinical Journal of Oncology Nursing, 17(6), 13–24.
Mitchell, S. A., Hoffman, A. J., Clark, J. C., et al. (2014). Putting evidence into practice: An update of evidence-based interventions for cancer-related fatigue during and following treatment. Clinical Journal of Oncology Nursing, 18(6), S38–S58.
Montezano A. C., Dulak-Lis, M., Tsiropoulou S., et al. (2015). Oxidative stress and human hypertension: Vascular mechanisms, biomarkers, and novel therapies. Journal of Canadian Cardiology, 31(5), 631–641.
National Cancer Institute (NCI). (2016). Cancer genetics overview for health professionals. Retrieved on 3/2/2016 at: www.cancer.gov/cancertopics/pdq/genetics/overview/healthprofessional
National Comprehensive Cancer Network (NCCN). (2015a). Clinical practice guidelines in oncology: Genetic/familial high risk assessment: Breast and ovarian. Retrieved on 3/7/2016 at: www.nccn.org/professionals/physician_gls/pdf/genetics_screening.pdf
National Comprehensive Cancer Network (NCCN). (2015b). Clinical practice guidelines in oncology: Genetic/familial high risk assessment: Colorectal. Retrieved on 3/7/2016 at: www.nccn.org/professionals/physician_gls/pdf/genetics_colon.pdf
National Comprehensive Cancer Network (NCCN). (2015c). Clinical practice guidelines: Breast. Retrieved on 3/7/2016 at: www.nccn.org/professionals/physician_gls/PDF/infections.pdf
National Comprehensive Cancer Network (NCCN). (2015d). NCCN clinical practice guidelines in oncology: Prostate cancer. Retrieved on 3/10/2016 at: www.nccn.org/professionals/physician_gls/pdf/prostate.pdf
National Comprehensive Cancer Network (NCCN). (2015e). NCCN clinical practice guidelines in oncology: Antiemesis. Retrieved on 3/11/2016 at: www.nccn.org/professionals/physician_gls/pdf/antiemesis.pdf
National Comprehensive Cancer Network (NCCN). (2015f). NCCN guidelines for supportive care: Cancer related fatigue. Retrieved on 3/24/2016 at: www.nccn.org/professionals/physician_gls/f_guidelines.asp#fatigue
National Comprehensive Cancer Network (NCCN). (2015g). NCCN clinical practice guidelines in oncology: Distress [v.2.2015]. Retrieved on 3/28/2016 at: http://www.nccn.org/professionals/physician_gls/pdf/distress.pdf
National Comprehensive Cancer Network (NCCN). (2015h). NCCN clinical practice guidelines in oncology: Prevention and treatment of cancer-related infection [v.2.2015]. Retrieved on 3/28/2016 at: http://www.nccn.org/ professionals/physician_gls/pdf/infections.pdf
National Comprehensive Cancer Network (NCCN). (2015i). NCCN clinical practice guidelines in oncology: Cancer-associated thromboembolic disease [v.1.2015]. Retrieved on 4/24/2016 at: http://www.nccn.org/professionals/physician_gls/pdf/vte.pdf
National Institutes of Health, National Center for Complementary and Integrative Health (NCCIH). (2015). Complementary, alternative, or integrative health: What's in a name? Retrieved on 10/10/2015 at: nccih.nih.gov/health/integrative-health
Neuss, M. N., Polovich. M., McNiff, K., et al. (2013). 2013 Updated American Society of Clinical Oncology/Oncology Nursing Society chemotherapy administration safety standards including standards for the safe administration and management of oral chemotherapy. Oncology Nursing Forum, 40(3), 225–233.
Niklas, C., Saar, M., Berg, B., et al. (2016). da Vinci and open radical prostatectomy: Comparison of clinical outcomes and analysis of insurance costs. Urologia International, 96(3), 287–294.
Oeffinger, K. C. (Ed). (2013). Science of survivorship: Moving from risk to risk reduction. Seminars in Oncology, 40(6), 659–812, S1–S4.
O'Gorman, C., Sasiadek, W., Denieffe, S., et al. (2015). Predicting radiotherapy-related clinical toxicities in cancer: A literature review. Clinical Journal of Oncology Nursing, 18(3), 37–44.
Pachman, D., Price, K. A., & Carey, E. C. (2014). Nonpharmacologic approach to fatigue in patients with cancer. The Cancer Journal, 20(5), 313–318.
Parihar, A., (2015). Genetic and environmental factors in cancer pathogenesis. International Journal of Research-Granthaalyah, 3(9), 1-3.
Schiller, J. T., & Lowy, D. R. (2014). Virus infection and human cancer: An overview. Recent Results in Cancer Research. 193, 1–10.
Schilli, S. M. (2014). Screening for distress in patients with cancer. Clinical Journal of Oncology Nursing, 18(6), E103–E106.
Shackelford, J. A., Weyhenmeyer, D. P., & Mabus, L. K. (2015). Fostering early breast cancer detection: Faith community nurses reaching at-risk populations. Oncology Nursing Forum, 18(6), 113–118.
Siegel, R. L., Miller, K. D., & Jemal, A. (2015). Cancer statistics, 2015. Cancer Journal for Clinicians, 65(1), 5–29.
Smith, A. (2015). A workshop for educating nurses to address sexual health in patients with breast cancer. Clinical Journal of Oncology Nursing, 19(3), 248–250.
Smith, T. J., Bohlke, K., Lyman, G. H., et al. (2015). Recommendations for the use of WBC growth factors: American Society of Clinical Oncology clinical practice guideline update. Journal of Clinical Oncology, 33(28), 3199–3212.
Tayyem, A. Q. (2014). Cryotherapy effect on oral mucositis severity among recipients of bone marrow transplantation: A literature review. Clinical Journal of Oncology Nursing, 18(4), E84–E87.
Tipian, C. (2014). Brushing up on mouth care for cancer patients with mucositis. American Nurse Today, 9(11), 38–40.
Thomson, C. A., McCullough, M. L., Wertheim, B., et al. (2014). Nutrition and physical activity cancer prevention guidelines, cancer risk, and mortality in the Women's Health Initiative. Cancer Prevention Research, 7(1), 42–53.
Tofthagen, C., Visovsky, C. M., & Hopgood, R. (2013). Chemotherapy-induced peripheral neuropathy: An algorithm to guide nursing management. Clinical Journal of Oncology Nursing, 17(2), 138–144.
U.S. Department of Health and Human Services, Public Health Service. (2012). What you need to know about breast cancer. Bethesda, MD: National Institutes of Health.
Vadhan-Raj, S., Goldberg, J. D., Perales, M. A., et al. (2013). Clinical applications of palifermin: Amelioration of oral mucositis and other potential indications. Journal of Cell & Molecular Medicine. 17(11), 1371–1384.
Vioral, A., Leslie, M., Best, R., et al. (2014). Patient adherence with oral oncolytic therapies. Seminars in Oncology Nursing, 30(3), 190–199.
**Vogel, V. G., Costantino, J. P., Wickerham, D. L., et al. (2010). Update of the national surgical adjuvant breast and bowel project study of Tamoxifen and Raloxifene (STAR) P- 2 Trial: Preventing breast cancer. Cancer Prevention Research, 3(6), 696–706.
Von Ah, D. (2015). Cognitive changes associated with cancer and cancer treatment: State of the science. Clinical Journal of Oncology Nursing, 19(1), 47–56.
Wallace, A., Robinson, C., Myer, J., et al. (2015). The metastatic spine disease multidisciplinary working group algorithms. The Oncologist, 20(9), 1–11.
Wang, L., Jian, Y., Yang, G., et al. (2015). Management of tumor lysis syndrome in patients with multiple myeloma during bortezomib treatment. Clinical Journal of Oncology Nursing, 19(1), E4–E7.
Weber, J. S. (2014). Immuno-oncology comes of age. Seminars in Oncology, 41(5), S1–S2.Yagasaki, K., & Komatsu, H. (2013). The need for a nursing presence in oral chemotherapy. Clinical Journal of Oncology Nursing, 17(5), 512–516.
Zweizig, S., Korets, S., & Cain, J. (2014). Key concepts in management of vulvar cancer. Best Practices & Research: Clinical Obstetrics & Gynecology, 28(7), 959–966.

Resources

American Association of Cancer Research (AACR), www.aacr.org
American Cancer Society (ACS), www.cancer.org/
American College of Surgeons Commission on Cancer (CoC), https://www.facs.org/quality-programs/cancer/coc
American Pain Society (APS), www.ampainsoc.org
American Society of Clinical Oncology (ASCO), www.asco.org

American Society for Radiation Oncology (ASTRO), www.astro.org
Association of Oncology Social Work (AOSW), http://www.aosw.org
Cancer Care, http://www.cancercare.org/
Centers for Disease Control and Prevention (CDC): Cancer Control and Prevention: http://www.cdc.gov/cancer/
Hospice and Palliative Nurses Association (HPNA), www.hpna.org
Indian Cancer Society, www.indiancancersociety.org
LIVESTRONG Survivorship Centers of Excellence, www.livestrong.org
National Cancer Institute (NCI), www.cancer.gov
National Institutes of Health, National Center for Complementary and Integrative Health (NCCIH), nccih.nih.gov
National Coalition for Cancer Survivorship, www.canceradvocacy.org
National Comprehensive Cancer Network (NCCN), www.nccn.org
National Hospice and Palliative Care Organization, www.nhpco.org
OncoLink (cancer resources), www.oncolink.org
Oncology Nursing Society (ONS), www.ons.org
Quackwatch, www.quackwatch.org
The Bone Marrow Foundation, http://bonemarrow.org/
The Cancer Support Community, http://www.cancersupportcommunity.org/
The Leukemia and Lymphoma Society, www.lls.org
The Oncology Nurses Association of India, https://www.uicc.org/membership/oncology-nurses-association-india

CHAPTER 59

Palliative Care and End-of-Life Care

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1 Discuss the historical, legal, and sociocultural perspectives of palliative and end-of-life care.
2 Define palliative and end-of-life care.
3 Explain the current scenario of palliative care in India.
4 Compare and contrast the settings where palliative care and end-of-life care are provided.
5 Describe the principles and components of hospice care.
6 Identify barriers to improving care at the end of life.
7 Reflect on personal experience with and attitudes toward death and dying.
8 Apply skills for communicating with seriously ill patients and their families.
9 Provide culturally and spiritually sensitive care to seriously ill patients and their families.
10 Implement nursing measures to manage physiologic responses to terminal illness.
11 Support imminently dying patients and their families.
12 Identify components of uncomplicated grief and mourning and implement nursing measures to support patients and families.

GLOSSARY

assisted suicide: providing another person the means to end their own life
autonomy: self-determination; in the health care context, the right of the individual to make choices about the use and discontinuation of medical interventions
bereavement: period during which mourning for a loss takes place
euthanasia: Greek for "good death"; has evolved to mean the intentional killing by act or omission of a dependent human being for their alleged benefit
grief: personal feelings that accompany an anticipated or actual loss
hospice: a coordinated program of interdisciplinary care and services for terminally ill patients and their families that in the United States is provided primarily in the home
interdisciplinary collaboration: communication and cooperation among members of diverse health care disciplines jointly to plan, implement, and evaluate care
mourning: individual, family, group, and cultural expressions of grief and associated behaviors
palliative care: philosophy of and system for delivering care that expands on traditional medical care for serious, progressive illness to include a focus on quality of life, function, decision making, and opportunities for personal growth
palliative sedation: the use of pharmacologic agents, at the request of the terminally ill patient or the patient's legal proxy, to induce sedation, or near-sedation, when symptoms have not responded to other management measures; the purpose is not to hasten the patient's death but to relieve intractable symptoms
prognosis: the expected course of an illness and the chance for recovery
spirituality: personal belief systems that focus on a search for meaning and purpose in life, intangible elements that impart meaning and vitality to life, and a connectedness to a higher or transcendent dimension
terminal illness: progressive, irreversible illness that despite cure-focused medical treatment will result in the patient's death

Introduction

Nurses can have a significant and lasting effect on the way patients live until they die, the manner in which the death occurs, and the enduring memories of that death for the families. The contemporary definition of nursing includes "…the diagnosis and treatment of human responses, and advocacy in the care of individuals, families, groups, communities, and populations" (American Nurses Association [ANA], 2015), p. 1). There may be no group more important than seriously ill and dying patients.

Knowledge about palliative and end-of-life principles of care and patients' and families' unique responses to illness is essential to supporting their unique values and goals. Nurses have an opportunity to bring research, education, and practice together to impact the culture of dying, bringing much-needed improvement to care that is relevant across practice settings, age groups, cultural backgrounds, and illnesses. The National Institute of Nursing Research established the Office of End-of-Life and Palliative Care Research (OEPCR) to further advance the science and coordinate research-related to end-of-life care within the National Institutes of Health (NIH). Nurses in all settings are likely to encounter seriously ill patients and families who can benefit from palliative care during advanced illness and at end of life. This chapter presents concepts about death and dying, settings for end-of-life care of the dying, and ways that nurses can address the health issues of terminally ill patients.

Nursing and End-of-Life Care

Death and Dying

Focus on care of the dying is motivated by the aging of the population, the prevalence of and publicity surrounding life-threatening illnesses, and the increasing likelihood of a prolonged period of chronic illness prior to death (e.g., cancer and noncancer diagnoses such as heart failure, chronic

obstructive pulmonary disease (COPD), and Alzheimer's disease). Although there are more opportunities than ever before to support peaceful death, the technologies that are often applied in advanced illness and at end of life continue to make the process of dying anything but peaceful. Patients, families, and clinicians may view death as what happens when medicine fails. This attitude places death and improvement of the dying process outside the focus of modern medicine and health care. Numerous initiatives aimed at improving end-of-life care have been launched in recent years.

In USA, the National Consensus Project for Quality Palliative Care (NCP, 2013) identified the following eight key domains underlying a more comprehensive and humane approach to care of the dying. These include:

- **Structure and processes of care:** The timely plan of care is based on a comprehensive interdisciplinary assessment of the patient and the family.
- **Physical aspects of care:** Pain, other symptoms, and side effects are managed based on the best available evidence, with attention to disease-specific pain and symptoms, which is skillfully and systematically applied.
- **Psychological and psychiatric aspects of care:** Psychological status is assessed and managed based on the best available evidence, which is skillfully and systematically applied. When necessary, psychiatric issues are addressed and treated.
- **Social aspects of care:** Comprehensive interdisciplinary assessment identifies the social needs of patients and their families, and a plan of care is developed to respond to these needs as effectively as possible.
- **Spiritual, religious, and existential aspects of care:** Spiritual and existential dimensions are assessed and responded to based on the best available evidence, which is skillfully and systematically applied.
- **Cultural aspects of care:** The palliative care program assesses and attempts to meet the needs of the patient, family, and community in a culturally sensitive manner.
- **Care of the patient at the end of life:** Signs and symptoms of impending death are recognized and communicated in developmentally appropriate language for children and patients with cognitive disabilities with respect to family preferences. Care appropriate to this phase of illness is provided to the patient and the family.
- **Ethical and legal aspects of care:** The patient's goals, preferences, and choices are respected within the limits of applicable state and federal law, within current accepted standards of medical care, and form the basis for the plan of care.

The practice guidelines specified under each of these domains have been endorsed by more than 50 national organizations such as the AARP (formerly known as the American Association for Retired Persons), American Cancer Society (ACS), Hospice and Palliative Nurses Association (HPNA), and the National Hospice and Palliative Care Organization (NHPCO) to structure and evaluate quality palliative and end-of-life programs.

In 2014, the Institute of Medicine (IOM) released a consensus report titled *Dying in America: Improving Quality and Honoring Individual Preferences Near the End of Life.* The report presents a summary of findings from a review of the evidence and recommendations for improving palliative and end-of-life care. The authors noted that patients experienced many transitions in settings, frequent and potentially avoidable hospital readmission, and inconsistent referral to palliative care. Recommendations include widespread and timely access to, and comprehensive coverage for palliative care services, improved communication between providers, greater emphasis on advance care planning, professional education and development, and stronger public education and engagement (IOM, 2014a). It is expected that such initiatives will also be followed in developing countries including India.

Technology and End-of-Life Care

In the 20th century, chronic, degenerative diseases replaced communicable diseases as the major causes of death. In the earlier part of the 20th century, most deaths occurred at home and most families had direct experience with death, providing care to family members at the end of life and then mourning their losses. As the place of death shifted from home to hospitals, families became increasingly distanced from the death experience.

The application of technology to prolong life raises numerous ethical issues. One major question is: Because we *can* prolong life through increasingly sophisticated technology, does it necessarily follow that we *must* do so? In the latter half of the 20th century, a "technologic imperative" practice pattern among health care professionals emerged, along with an expectation among patients and families that every available means to extend life must be tried.

In the 21st century, technological intervention at the end of life continues to have profound implications, affecting how clinicians care for the dying, how family and friends participate in care, how patients and families understand and choose among end-of-life care options, how families prepare for terminal illness and death, and how they heal after the death of a loved one.

Sociocultural Context

Although terminal illness, a progressive, irreversible illness that despite cure-focused medical treatment will result in the patient's death, is experienced uniquely by each person, it is also shaped by the broader social and cultural contexts in which it occurs. The new approach to serious illness has been described as "death denying"—that is, the health care system has been built on management of acute illness and the use of technology to cure (when possible) and to extend life. As a result, life-threatening illness, life-sustaining treatment decisions, dying, and death occur in a social environment in which illness is largely considered an enemy. Many common expressions reflect this dominant sociocultural view. For example, people talk about the "war" against cancer or "fighting" illness, and when patients choose not to pursue the most aggressive course of medical treatment available, many health care providers and indeed patients and families perceive this as "giving up." A care/cure dichotomy has persisted in which health care providers may view cure as the ultimate good and care as second best, a good only when cure is no longer possible. In such a model, alleviating suffering is not as valued as curing disease. Patients who cannot be cured feel distanced from the health care team, and when curative treatments have failed, they may feel that they too have failed. Patients and families may fear that any shift from curative goals to comfort-focused care will result in no care or lower-quality care, and that the clinicians on whom they have come to rely will abandon them if they withdraw from a focus on cure.

The statement in late-stage illness that exemplifies this care versus cure dichotomy is "nothing more can be done." This all-too-frequently used statement communicates the belief of

many clinicians that there is nothing of value to offer patients beyond cure; however, in a care-focused perspective, there is always more that can be done. This expanded notion of healing implies that healing can take place throughout life. There are many opportunities for physical, spiritual, emotional, and social healing, even as body systems begin to fail at the end of life.

Clinicians' Attitudes Toward Death

Clinicians' attitudes toward the terminally ill and dying remain the greatest barrier to improving care at the end of life. Kübler-Ross illuminated the concerns of the seriously ill and dying in her seminal work, *On Death and Dying,* first published in 1969. At that time, it was common for patients to be kept uninformed about life-threatening diagnoses, particularly cancer, and for physicians and nurses to avoid open discussion of death and dying with their patients. Kübler-Ross's work revealed that, given open discussion, adequate time, and some help in working through the process, patients could reach a stage of acceptance in which they were neither angry nor depressed about their fate (see later discussion).

Clinicians' reluctance to discuss disease and death openly with patients stems from their own anxieties about death as well as misconceptions about what and how much patients want to know about their illnesses. In an early study of care of the dying in hospital settings, sociologists Glaser and Strauss (1965) discovered that health care professionals in hospital settings avoided direct communication about dying in the hope that the patient would discover it on their own. They identified four "awareness contexts":

1. **Closed awareness:** The patient is unaware of their terminal state, whereas others are aware. Closed awareness may be characterized as a conspiracy between the family and the health care professionals to guard the "secret," fearing that the patient may not be able to cope with full disclosure about their status and the patient's acceptance of others' accounts of their "future biography" as long as the others give him or her no reason to be suspicious.
2. **Suspected awareness:** The patient suspects what others know and attempts to find out details about their condition. Suspected awareness may be triggered by inconsistencies in the family's and the clinician's communication and behavior, discrepancies between clinicians' accounts of the seriousness of the patient's illness, or a decline in the patient's condition or other environmental cues.
3. **Mutual pretense awareness:** The patient, the family, and the health care professionals are aware that the patient is dying, but all pretend otherwise.
4. **Open awareness:** The patient, the family, and the health care professionals are aware that the patient is dying and openly acknowledge that reality.

Glaser and Strauss (1965) also identified a pattern of clinician behavior in which those clinicians who feared or were uncomfortable discussing death developed and substituted "personal mythologies" for appraisals of what level of disclosure their patients actually wanted. For example, clinicians avoided direct communication with patients about the seriousness of their illness based on their beliefs that (1) patients already knew the truth or would ask if they wanted to know, or (2) patients would subsequently lose all hope, give up, or be psychologically harmed by disclosure.

Although Glaser and Strauss's findings were published decades ago, their observations remain valid today. The growth of palliative and hospice care programs has led to greater numbers of health care providers becoming comfortable with and skilled in assessing patients' and families' information needs and disclosing honest information about the seriousness of illness (Bernacki & Block, 2014). However, in many settings, clinicians still avoid the topic of death in the hope that patients will ask or find out on their own. Despite progress on many health care fronts, many who work with seriously ill and dying patients recognize a persistent conspiracy of silence about dying.

How to communicate truthfully with patients and encourage patient autonomy (the right of the individual to make choices) in a way that acknowledges where they are on the continuum of acceptance is a challenge. Despite continued reluctance of health care providers to engage in open discussion about end-of-life issues, patients want information about their illness and end-of-life choices and are not harmed by open discussion about death (The Conversation Project, 2013); (Hoff & Hermeren, 2014). Timing of sensitive discussion takes experience, but speaking the truth can be a relief to patients and families, enhancing their autonomy by making way for truly informed consent as the basis for decision making. (See later section for detailed discussion of communication skills.)

Patient and Family Concerns

Patient and family denial about the seriousness of terminal illness has also been cited as a barrier to discussion about end-of-life treatment options. Yet, research demonstrates that denial can be a useful coping mechanism that enables the patient to gain temporary emotional distance from a situation that is too painful to contemplate fully (Benkel, Wijk, & Molander, 2010). Denial may become a *barrier* to care if patients or families refuse to acknowledge a diagnosis or refuse to hear about treatment options. Nurses must accept patients regardless of the degree to which they are in denial about their illness and work with other health care providers to present a consistent message.

Patient and family awareness of prognosis is a key factor in acceptance of and planning for death. Even patients and families who have received clear and honest information may not fully accept the situation. For patients who have been informed about terminal illness, their understanding of treatment goals and prognosis is dynamic and may sometimes require reinforcement.

Another concern is that patients' and their caregivers' understanding of treatment goals and prognosis can differ dramatically. In a study of patients receiving palliative radiation therapy for metastases, researchers found that 25% of patients believed that radiation therapy would cure the cancer and prolong their lives (Mitera, Zhang, Sahgal, et al., 2012). Such misunderstandings can complicate both delivery of effective care and informed consent for care.

Patients with noncancer diagnoses, such as heart failure, COPD, kidney injury, dementia, or neurodegenerative diseases such as amyotrophic lateral sclerosis, frequently do not receive adequate information and support to fully understand their prognosis, yet they often desire clear and honest information. For example, they may have troublesome symptoms and reduced quality of life paralleling or exceeding that of patients with cancer. Patients may want but are unlikely to receive clear information about disease progression, advance care planning, and prognosis. Research is needed to examine the complex interactions between patients' misconceptions about advanced

Chart 59-1 ETHICAL DILEMMA

What if a Patient Asks You to Help Her End Her Life?

Case Scenario

You are a hospice nurse making a first home visit to a 54-year-old woman, a registered nurse, with stage IV ovarian cancer with metastases to her lungs and liver. She now reports severe dyspnea and chest and abdominal pain that is increasing and unrelieved by any of the pharmacologic and nonpharmacologic interventions that have been tried. In addition, she appears grossly jaundiced and cachectic. Prior to her illness, she worked as a staff nurse in an oncology unit at a local hospital. She is married, with three children, one of whom is in college and studying nursing, and two of whom are in high school. The patient tells you "My oldest daughter is ready to enter her senior year of nursing school. She has told me she is going to drop out of school so she can take care of me and I don't want her to do that." She then tells you "I know what is in store for me and I don't want to go through that, and I do not want to ruin my daughter's career and her life. I want you to help me end things and if you do not, I will take care of ending things myself, on my own terms."

Discussion

Assisted suicide remains a highly controversial topic—is it a matter of personal choice (i.e., does it preserve the autonomy of those who are dying), or does it constitute homicide by health care professionals who should "first do no harm" (i.e., nonmaleficence)? At this time, five states in the United States (Oregon, Washington, Montana, Vermont, and California) legally permit physician-assisted suicide. However, the laws in these states include highly prescriptive criteria that must be present before a patient may be given a lethal prescription to end their own life. The American Nurses Association, in its *Euthanasia, Assisted Suicide, and Aid in Dying Position Statement* (ANA, 2013), acknowledges the importance of the patient's right to self-determination, advocates that nurses must deliver optimal, compassionate care but avows that the nurse must never deliberately end a patient's life by euthanasia or physician-assisted suicide.

Analysis

How might you proceed with providing further consultation or follow-up with this patient? Would this follow-up be based upon whether or not she resided in a state where physician-assisted suicide is legal? Would her state of residence have any effect on your personal decision-making process?

Further describe the ethical principles that are in conflict in this case and in other cases that surround requests for assisted suicide (see Chart 2-3). Which principle do you believe should have preeminence in deciding whether or not patients have the right to request assistance in suicide at the end of life? Identify other resources or referrals that could be made to assist this patient in her end-of-life care.

Reference

American Nurses Association (2013). *Euthanasia, assisted suicide, and aid in dying position statement.* Retrieved on 8/27/2016 at: www.nursingworld.org/MainMenuCategories/EthicsStandards/Ethics-Position-Statements/Euthanasia-Assisted-Suicide-and-Aid-in-Dying.pdf

Resources

See Chapter 2, Chart 2-6 for ethics resources.

illness, their underlying psychological states, and barriers to clinicians' explanations of treatment expectations and prognosis.

Euthanasia

On 7 March 2018, the Supreme Court of India legalized passive euthanasia by means of the withdrawal of life support to patients in a permanent vegetative state (see Chart 59-1). The decision was made as part of the verdict in a case involving Aruna Shanbaug, who was in a persistent vegetative state (PVS) until her death in 2015.

In March 2015, the Supreme Court of India passed a historic judgement—law permitting passive euthanasia in the country. This judgment was passed in the wake of Pinki Virani's plea to lust the highest court in December 2009 under the Constitutional provision of "Next Friend." It's a landmark law which places the power of choice in the hands of the individual over government, medical, or religious control which see all suffering as "destiny."

Settings for End-of-Life Care

Palliative Care

Palliative care is an approach to care for the seriously ill that has long been a part of cancer care. More recently, it has been expanded to address the comprehensive symptom management, psychosocial care, and spiritual support needed to enhance the quality of life for any person with advanced illness. Although hospice care is considered by many to be the gold standard for palliative care, the term hospice is generally associated with palliative care that is delivered at home or in special facilities to patients who are approaching the end of life (see later discussion). Palliative care and hospice care have been recognized as important bridges between cure-oriented treatment and the needs of terminally ill patients and their families for comprehensive care in the final years, months, or weeks of life. Advocates for improved care for the dying have stated that acceptance, management, and understanding of death should become fully integrated concepts in mainstream health care.

Palliative care, which is conceptually broader than hospice care, is both an approach to care and a structured system for care delivery that aims to optimize "quality of life by anticipating, preventing and treating suffering" (NCP, 2013), p. 9). Palliative care is characterized by interdisciplinary communication and coordination across the trajectory of serious illness, emphasizing management of psychological, social, and spiritual problems in addition to control of pain and other physical symptoms. As the definition suggests, palliative care does not begin when cure-focused treatment ends but instead is offered "concurrently with or independent of curative or life-prolonging care" (NCP, 2013), p. 9). The goal of palliative care is to improve the patient's and family's quality of life, and indeed many aspects of this type of comprehensive, comfort-focused approach to care are applicable earlier in the process of life-threatening disease and in conjunction with cure-focused treatment.

In palliative care, interdisciplinary collaboration is necessary to bring about the desired outcomes for patients and their families. Interdisciplinary collaboration, which is different from

multidisciplinary practice, is based on communication and cooperation among the various disciplines, with each member of the team contributing to a single integrated care plan that addresses the needs of the patient and the family. In contrast, multidisciplinary care refers to participation of clinicians with varied backgrounds and skill sets but without coordination and integration.

Palliative Care at the End of Life

The broadening of the application of palliative care *followed* the development of hospice programs. All hospice care is palliative care; however, not all palliative care is hospice care. The difference is that hospice care is an application of palliative care delivered at the end of life. Hospice care focuses on quality of life, and by necessity, it usually includes realistic emotional, social, spiritual, and financial preparation for death.

Hospice providers endeavor to make the services available to all persons with advanced illness, regardless of diagnosis. Many chronic progressive diseases do not have a predictable "end stage" that fits hospice eligibility criteria, and as a result, many patients die after a long, slow, and often painful decline, without the benefit of the coordinated palliative care that is unique to hospice programs. The palliative approach to care could benefit many more patients if it were available across care settings and earlier in the disease process. Palliative care programs are now being developed in other settings for patients who are either not eligible for hospice or who do not choose to enroll in a formal hospice program. At this time, there is no dedicated reimbursement to providers for palliative care services when they are delivered outside the hospice setting, making the sustainability of such programs challenging.

Palliative Care in the Hospital Setting

Hospitals have a financial incentive to transfer patients with terminal illnesses who are no longer in need of acute care to receive care in other settings, such as long-term care facilities and home. Despite the economic and human costs associated with death in the hospital setting, approximately 30% of all deaths occur in acute care settings.

Many patients will continue to opt for hospital care or will by default find themselves in hospital settings at the end of life. Increasingly, hospitals are conducting system-wide assessments of end-of-life care practices and outcomes and are developing innovative models for delivering high-quality, person-centered care to patients approaching the end of life. A growing body of evidence supports the role of palliative care that is delivered *concurrently* with standard medical treatment. For example, in a landmark study of referral to palliative care for patients newly diagnosed with metastatic non–small cell lung cancer (a disease with very poor prognosis), researchers found that those patients randomized to the palliative care plus standard oncology care arm of the trial not only showed improved quality of life and mood but also had longer median survival than those who received standard oncology care alone (Temel, Greer, Muzikansky, et al., 2010). This study underscores the value of palliative care and undercuts one of the principal objections to palliative care, which equates it with "giving up."

In 2011, The Joint Commission launched an advanced certification program for palliative care to recognize hospitals that provide exceptional patient and family-centered care. Despite early financial barriers to providing high-quality palliative care in acute care settings (Connor, 2007–2008), palliative care services in hospitals have grown significantly; in 2015, almost all large hospitals (90%) had a palliative care program (Center to Advance Palliative Care [CAPC], 2015a). Public policy changes have been called for that would reimburse hospitals for care delivered via designated hospital-wide palliative care beds, clustered palliative care units, or palliative care consultation services in acute care settings. Resources are available for developing hospital–hospice partnerships to provide high-quality palliative care for hospitalized patients and for addressing the palliative care needs of other specialized populations, such as patients receiving such care in intensive care units (ICUs), pediatric patients, residents of long-term care facilities, and patients receiving care in community settings (CAPC, 2015b). In a statewide survey of hospitals, researchers found that although 89% of Maryland providers already had a palliative care program in place, 41% indicated that they did not have procedures in place for ensuring timely delivery of services (Gibbs, Mahon, Truss, et al., 2015). This action by the Maryland legislature is an example of state policy that can contribute to wider adoption of palliative care.

Outpatient Palliative Care

As palliative care has become more prevalent in hospitals, skilled nursing settings, and in home hospice programs, outpatient palliative care has emerged as an approach to providing services and support to patients and families who opt not to or are not eligible for home hospice but could benefit from comprehensive palliative care in the community. Outpatient palliative care benefits both patients and their families and other providers by providing expert consultation and management of symptoms and other needs. Studies demonstrate that outpatient palliative care increases patient satisfaction with care, improves symptom management and quality of life, reduces utilization of other health care services (such as avoidable acute care admissions), and may lengthen survival for some patients (Rabow, Kvale, Barbour, et al., 2013).

Palliative Care: The Indian Scenario

Magnitude of the Problem

According to WHO (2020), more than 56 million people, with an equal proportion of men and women, are in need of palliative care worldwide. The regional distribution of people needing palliative care varies widely across the globe. In the Western Pacific region, more than 25% of population are in need of palliative care, whereas in the South-East region, 17% of population need palliative care. In Africa, people requiring palliative care are primarily those suffering from HIV/AIDS. In all the regions of the world, a higher proportion of people diagnosed with cancer require palliative care.

In India, nearly 5 million people are in need of palliative care but only 1% of them have access to it. Every year, 2.5 million new cases of cancers are identified in India. Out of that, two-thirds reach the hospital in an incurable state suffering severe pain. Nearly 80% of patients with AIDS suffer moderate to severe pain. Patients suffering from other diseases such as heart failure and COPD add to the burden. The common distressing symptoms are pain, dyspnea, fatigue, nausea, vomiting, dry mouth, diarrhea, constipation, urinary incontinence, wound with smelly discharge, confusion, delirium, and dementia. To meet the palliative care needs of patients, the Government of India plans to integrate it into the primary care delivery system.

In India, only 908 palliative care centers are available, mostly in the state of Kerala (Khanna & Lal, 2016). In 2008, Kerala state brought into effect the palliative care policy followed by Maharashtra in 2012. In 2013, the Government of India launched

its National Programme for Palliative Care. Subsequently, in 2014, the Narcotic Drugs and Psychotropic Substances Act was amended and paved way for easier access to opioid medication which is necessary for pain relief. In 2016, in the International Palliative Care Conference held at Pune, a declaration was made urging the Government of India to integrate palliative care with noncommunicable diseases program and also with TB and AIDS control program so that patients with both communicable (HIV/AIDS) and noncommunicable diseases will receive the palliative care (Khanna & Lal, 2016).

With the introduction of the new National Health Policy (2017), the palliative care is given more importance. Recently, basic palliative care is integrated into the undergraduate medical and nursing curriculum by the National Medical Commission of India and Indian Nursing Council, respectively. Under the Ayushman Bharat scheme, medical officers, staff nurses, and ASHA workers are trained in palliative care delivery (Government of India, 2021).

Delivery of Palliative Care in India

As per the National Health Policy (2017), palliative care is provided at the primary health center level on an outpatient basis or inpatient basis. Whenever necessary, patients are referred to higher-level centers with palliative care specialists. The training modules provide step-by-step guidelines on symptom assessment and management. See Figure 59-1 for the algorithm for delivery of palliative care. In countries like India, home care palliative services are economically beneficial. Family members' involvement and natural environment give the patients more satisfaction; especially at the time of dying, people prefer to be with their loved ones in their home environment and follow the rituals or spiritual practices of their community. The secondary and tertiary level palliative care centers provide palliative services alongside other treatment modalities (e.g. spine care centers, palliative care centers along with oncology units).

Nurses' Role in Palliative Care

- Play a vital role in primary, secondary, and tertiary palliative care settings
- Play a major role in accurately assessing and managing distressing physical symptoms
- Coordinate with other health providers such as physicians, physiotherapists, and counselors
- Play a supervisory role and supervise the works of axillary nurse midwives (ANMs), accredited social health activist (ASHA) workers, and family caregivers
- Provide specialized palliative care services such as ostomy care, wound management, and lymphedema management
- Titrate pain medication and other drugs based on the protocols and manage the side effects if any
- Communicate effectively with family members and patients to facilitate good coping
- Educate and train the patients, family caregivers, and volunteers on effective home care with available resources
- Monitor and maintain the accurate records of palliative care services
- Provide referral services as appropriate
- Coordinate with the counselor in the terminal phase of illness
- Follow ethical and legal aspects of nursing while rendering palliative care services.

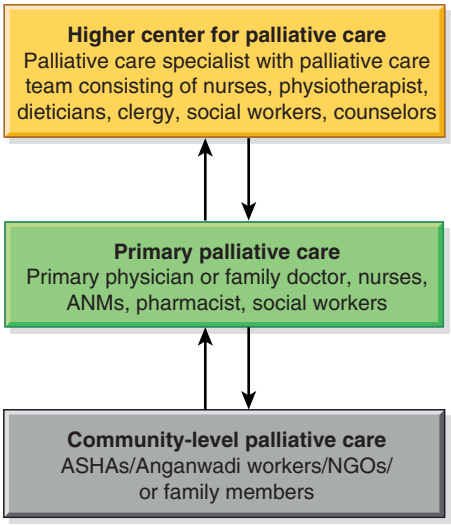


Figure 59-1 • Palliative care delivery algorithm. ANMs, axillary nurse midwives; ASHA, accredited social health activist; NGO, nongovernmental organization. *Source:* Adapted from Government of West Bengal & National Rural Health Mission. (2016). Training module on palliative care (for doctors and nurses).

Hospice Care

Hospice is a coordinated program of interdisciplinary services provided by professional caregivers and trained volunteers to patients with serious, progressive illnesses that are not responsive to cure. The root of the word *hospice* is *hospes,* meaning "host." According to Cicely Saunders, who founded the world-renowned St. Christopher's Hospice in London, the principles underlying hospice are as follows:

- Death must be accepted.
- The patient's total care is best managed by an interdisciplinary team whose members communicate regularly with one another.
- Pain and other symptoms of terminal illness must be managed.
- The patient and the family should be viewed as a single unit of care.
- Home care of the dying is necessary.
- Bereavement care must be provided to family members.
- Research and education should be ongoing.

Nursing Care of Terminally Ill Patients

Many patients suffer unnecessarily when they do not receive adequate attention for the symptoms accompanying serious illness. Careful evaluation of the patient should include not only the physical problems but also the psychosocial and spiritual dimensions of the patient's and family's experience of serious illness. This approach contributes to a more comprehensive understanding of how the patient's and family's life has been affected by illness and leads to nursing care that addresses their needs in every dimension.

Psychosocial and Regulatory Issues

Nurses are responsible for educating patients and their caregivers and for supporting them as they adapt to life with the illness. Nurses can assist patients and families with life review, values clarification, treatment decision making, and end-of-life goals. The only way to do this effectively is to try to appreciate and understand the illness from the patient's perspective.

Nurses should be both culturally aware and sensitive in their approaches to communication with patients and families about death. Attitudes toward open disclosure about terminal illness

vary widely among different cultures, and direct communication with patients about such matters may be viewed as harmful (Sarafis, Tsounis, Malliarou, et al., 2014). To provide effective patient- and family-centered care at the end of life, nurses must be willing to set aside their own assumptions and attitudes so that they can discover what type and amount of disclosure is most meaningful to each patient and family within their unique belief systems (see Table 59-1).

The social and legal evolution of advance directive documents represents some progress in people's willingness to both contemplate and communicate their wishes concerning the end of life (see Chart 59-2). Furthermore, the existence of a properly executed advance directive does not reduce the complexity of end-of-life decisions.

Communication

Remarkable strides have been made in the ability to prolong life; however, attention to care for the dying lags behind. On one level, this should come as no surprise. Each of us will eventually face death, and most would agree that one's own demise is a subject that he or she would prefer not to contemplate. Confronting death in our patients often uncovers our own deeply rooted fears.

To develop a level of comfort and expertise in communicating with seriously and terminally ill patients and their families, nurses must first consider their own experiences with and values concerning illness and death. Reflection, reading, and talking with family members, friends, and colleagues can help nurses examine beliefs about death and dying. Talking with people from different cultural and religious backgrounds can help nurses view personally held beliefs through a different lens and can increase their sensitivity to death-related beliefs and practices in other cultures. Discussion with nursing and nonnursing colleagues can also be useful; it may reveal the values shared by many health care professionals and may also identify diversity in the values of patients in their care. Values clarification and personal death awareness exercises can provide a starting point for self-discovery and discussion.

TABLE 59-1 Overview of Religious and Cultural Beliefs and Views on Death and Dying

Religion	General Religious/Cultural Beliefs	Views About Death/Preparing for Death
Hinduism	• Each caste has a different view of death. • This life is a transition between the previous life and the next. • Postdeath rituals are important. Bodies are cremated. During the first 10 days after death, relatives must create a new ethereal body. • Karma is the manner through which one reaps benefits and penalties of past actions. "Good karma" leads to good rebirth or release, and "bad karma" leads to bad rebirth. • Astrological timing of birth and death is important	• No firmly established medical ethics, principles, or codes to guide decision making/care. • Many older adults withdraw into their homes, where they prepare for death through prayer and meditation. • Family is very important; health care decisions may be made communally with senior family member as final authority. Deference to spouse and family may be especially prevalent among women (acquiescing autonomy to a family member). • A "good death" is timely, in the right place (on the ground at home), conscious and prepared, with the mind on God. All affairs should be in order. • A "bad death" is untimely, violent, and unprepared. The worst death is suicide. • Pain and suffering may be viewed as consequence of past actions, "bad karma".
Buddhism	• There is no central authority in the Buddhist religion. • Taboo and religious purity play little, if any, role, and religious law imposes no special requirements for medical treatment. • Treatment by someone of the same gender is preferable. • Cremation is the most common way of disposing of the dead. • Some Buddhists may be unwilling to take pain-relieving medications or strong sedatives. It is believed that an unclouded mind can lead to a better rebirth. • Buddhists believe that after death there is either rebirth or nirvana—the latter being enlightenment that frees the soul from the cycle of death and rebirth.	• Life is basically good and preserving it is important. Enlightenment can only be achieved through living. • Teachings emphasize the inevitability of death; therefore, Buddhists tend to be psychologically prepared to accept impending death with calmness and dignity. • Death occurs when a body is bereft of vitality, heat, and sentiency. Brain death is disputed as meeting the requirements for death. • It is often appropriate to decide that the patient is beyond medical help and to allow events to take their course. In these cases, it is justifiable to refuse or withdraw treatment in light of the overall prognosis. • Buddhism supports the use of hospice.
Islam	• Muslims believe in one God. • God revealed the message of God to Muhammad, the prophet, in the Qur'an (Koran), which states that Muslims should maintain a balanced diet and exercise. • Muslim patients may wish to engage in ritual prayer, practiced five times during the day. • Fasting during the month of Ramadan is a pillar of Islam. • Completion of the pilgrimage (*hajj*) to Mecca (money and health permitting), at least once, is also a pillar of Islam.	• Everyone will face death, and the way a person dies is of great individual importance. • Death cannot happen except by God's permission. However, it is recognized that diseases and trauma cause death. • There is a belief that God is the one who cures and primary providers are a means to enact God's will. • Decisions are made within families, and disclosure of diagnosis and prognosis must be considered in this context. • Pain is a cleansing instrument of God. Pain can also be viewed as having an educational purpose (pain can compensate for sin).

(Continued)

(Continued)

		• The killing of a terminally ill person is an act of disobedience against God. However, pain relief or withholding or withdrawing of life support when there is no doubt that the person's disease is causing untreatable suffering is permissible as long as there is formal agreement among all parties concerned. • Withholding and withdrawing artificial nutrition and hydration (ANH) at the end of life raises concerns. Nutritional support is considered basic care and not medical treatment and should be continued unless it would hasten death or cause more harm than benefit.
Traditional Christianity	• Christians believe in one God. • The belief in eternal salvation sets Christianity apart. • Beliefs vary. Some Christians hope to attain eternal salvation. • Even within family, religious views can differ. Some family members may not follow the religion at all.	• Each human life has inherent and equal dignity. • Intentionally bringing about death by either omission or commission is prohibited. • The appropriateness of analgesia and sedation to avoid terminal suffering and despair is acceptable, if it does not, by clouding consciousness, take away the final opportunity for repentance. • Christians are not obligated to postpone death; it is forbidden to try to save life at all costs. • However, there could be a duty to use high-technology medicine to gain a last opportunity for repentance. • ANH is obligatory for most patients except when the means to provide ANH cause complications, the patient has progressive illness, or clearly refuses ANH.
		• Impending death offers a final chance to become reconciled with those whom one has harmed and to ask God's forgiveness. • Liturgical (ceremonial) Christians generally regard last rites as integral to the relationship with God. Repentance can include confessing formally and receiving Communion and final anointing. This often involves particular ministers. • Christians who follow the religion at a cultural level are likely to have secular approaches to end-of-life decisions. • Advance directives allow patients to appoint decision makers and to provide instructions that ensure that their wishes are followed.

Adapted from Alsolamy, S. (2014). Islamic views on artificial nutrition and hydration in terminally ill patients. Bioethics, 28, 96–99. Dewar, R., Cahners, N., Mitchell, C., & Forrow, L. (2015). Hinduism and death with dignity: Historic and contemporary case examples. Journal of Clinical Ethics, 26(1), 40–47.
Linzer, R. D. (2013). Treatment of terminally ill patients according to Jewish law. The Virtual Mentor, 15, 1081–1087.
McCormick, A. J. (2013). Buddhist ethics and end-of-life care decisions. Journal of Social Work in End-of-Life & Palliative Care, 9, 209–225.
Zientek, D. M. (2013). Artificial nutrition and hydration in Catholic healthcare: Balancing tradition, recent teaching, and law. HEC Forum, 25, 145–159.

Chart 59-2

Methods of Stating End-of-Life Preferences

Advance directives: written documents that allow the individual of sound mind to document preferences regarding end-of-life care that should be followed when the signer is terminally ill and unable to verbally communicate their wishes. The documents are generally completed in advance of serious illness but may be completed after a diagnosis of serious illness if the signer is still of sound mind. The most common types are the durable power of attorney for health care and the living will.

Do Not Resuscitate: A medical order to withhold cardiopulmonary resuscitation (CPR) in the event of cardiac arrest. In some settings, the term "allow natural death" (AND) is used in place of do not resuscitate (DNR).

Durable power of attorney for health care: a legal document through which the signer appoints and authorizes another individual to make medical decisions on their behalf when he or she is no longer able to speak for himself or herself. This is also known as a health care power of attorney, medical power of attorney, or a proxy directive.

Living will: a type of advance directive in which the individual documents treatment preferences. It provides instructions for care in the event that the signer is terminally ill and not able to communicate their wishes directly and often is accompanied by a durable power of attorney for health care. This is also known as a medical directive or treatment directive.

Physician orders for life-sustaining treatment (POLST): a form that translates patient preferences expressed in advance directives to medical "orders" that are transferable across settings and readily available to all health care providers, including emergency medical personnel. The POLST form is a brightly colored form that specifies preferences related to CPR and use of IV medications or fluids, antibiotics, artificial nutrition, and other medical interventions. The form is signed by the patient or surrogate and the physician, advanced practice nurse, or physician assistant. The use of the POLST is subject to state laws and regulations. Numerous states have endorsed the POLST or a similar form.

Information about the advance care planning and state-specific advance directive documents and instructions is available at www.caringinfo.org. Information about the POLST is available at www.polst.org

Skills for Communicating with the Seriously Ill

Nurses need to develop skill and comfort in assessing patients' and families' responses to serious illness and planning interventions that support their values and choices throughout the continuum of care (Wittenberg-Lyles, Goldmith, Ferrell, et al., 2013). Throughout the course of a serious illness, patients and their families encounter complicated treatment options and bad news about disease progression. They may have to make difficult decisions at the time of diagnosis, when disease-focused treatment fails, when the effectiveness of a particular intervention is being discussed, and when decisions about hospice care are presented. These critical points on the treatment continuum demand patience, empathy, and honesty from nurses. Discussing sensitive issues such as serious illness, hopes for survival, and fears associated with death is never easy. However, the art of therapeutic communication can be learned and, like other skills, must be practiced to gain expertise. Like other skills, communication should be practiced in a "safe" setting, such as a classroom or clinical skills laboratory with other students and clinicians.

In practice, communication with each patient and family should be tailored to their particular level of understanding and values concerning disclosure. Before disclosing any health information about a patient to family members, nurses should follow their agency's policy for obtaining patient consent.

Nursing Interventions when Patients and Families Receive Bad News

Communicating about a life-threatening diagnosis or disease progression is best accomplished in any setting by the interdisciplinary team: A physician, nurse, and social worker, should be present whenever possible to provide information, facilitate discussion, and address concerns. Most important, the presence of the team conveys caring and respect for the patient and the family. If the patient wishes to have family present for the discussion, arrangements should be made to have the discussion at a time that is best for everyone. Creating the right setting is particularly important. A quiet area with a minimum of disturbances should be used. All clinicians present should turn off pagers, cell phones, and other communication devices for the duration of the meeting and should allow sufficient time for the patient and the family to absorb and respond to the news. Finally, the space in which the meeting takes place should be conducive to seating all participants at eye level. It is difficult enough for the patient and the family to be the recipients of bad news without having an array of clinicians standing uncomfortably over them at the foot of the patient's bed (see Chart 59-3).

After the initial discussion of a life-threatening illness or progression of a disease, the patient and the family will probably have many questions and may need to be reminded of factual information. Coping with news about a serious diagnosis or poor prognosis is an ongoing process. The nurse should be sensitive to these ongoing needs and may need to repeat previously provided information or simply be present while the patient and the family react emotionally. The most important intervention the nurse can provide is listening empathetically. Seriously ill patients and their families need time and support to cope with the changes brought about by serious illness and the prospect of impending death. The nurse who is able to listen without judging and without trying to solve the patient's and family's problems provides an invaluable intervention. Keys to effective listening include the following:

- Resist the impulse to fill the "empty space" in communication with talk.
- Allow the patient and the family sufficient time to reflect and respond after asking a question.
- Prompt gently: "Do you need more time to think about this?"
- Avoid distractions (noise, interruptions).

Chart 59-3

COMFORT: A Framework for Communication in Palliative Care

Communication (C)

- Narrative clinical practice: Elicit and be fully present for the patient's and family's story.
- Verbal clarity: Use compassionate, nonambiguous language.
- Nonverbal immediacy: Use eye contact, body position, and self-awareness to show attentiveness.

Orientation (O)

- Support health literacy.
- Acknowledge vulnerability.
- Express cultural sensitivity.

Mindfulness (M)

- Stay in the moment: Avoid scripted responses.
- Avoid prejudgment: Do not have expectations that this patient and family will or should respond as others have in the past.
- Adapt to rapid changes: Be ready to shift to new topics and concerns that are revealed.

Family (F)

- Think of the family as a "second-order" patient: The family and the patient comprise the unit of care.
- Know that the family is a bridge to the patient: You must gain the family's trust to work effectively.
- Use family meetings (patient included) to clarify goals for treatment.

Openings (O)

- Address essential transitions in care or status.
- Seek a higher level of understanding of the disease process.
- Engage spiritual concerns.

Relating (R)

- Prioritize the turning point in illness.
- Understand that communication should be nonlinear: The patient and the family may need to revisit topics multiple times and on multiple occasions.
- Know that the patient's and family's acceptance must drive communication.

Team (T)

- The interdisciplinary team includes members trained in various aspects of palliative care.
- Assure the patient and the family that they will not be abandoned.
- Ensure continuity of care across settings: Goals and plans should be clearly communicated to other providers.

Adapted with permission from Wittenberg-Lyles, E., Goldsmith, J., & Ragan, S. L. (2010). The COMFORT initiative: Palliative nursing and the centrality of communication. Journal of Hospice and Palliative Nursing, 12(5), 282–292.

Chart 59-4 NURSING RESEARCH PROFILE

Perceptions of Helpful Interventions During End-of-Life Care

Cronin, C., Arnstein, P., & Flanagan, J. (2015). Family members' perceptions of most helpful interventions during end-of-life care. Journal of Hospice & Palliative Nursing, 17(3), 223–228.

Purpose

Hospice care and support is directed not just to the patient but to those whom the patient considers family, as well. Numerous studies have provided insight to nurses' perceptions of priorities for as well as barriers to and facilitators of end-of-life care. Better understanding of families' needs could improve their experience of hospice care. This study aimed to explore the needs of family members and friends while their loved ones received end-of-life care in a hospital setting.

Design

This was a qualitative study in which the researchers used semi-structured interviews to collect data from a family member or close friend of a patient enrolled in hospice in a hospital setting. Nine potential study participants were identified through convenience sampling on an 18-bed gynecologic oncology unit in a large academic medical center; seven of the nine agreed to participate. Interview questions focused on perceived helpfulness of nurses' and other staff members' activities, perceptions of communication, and adequacy and helpfulness of referred services (e.g., chaplaincy). Data were compiled as transcripts from handwritten interview notes and analyzed using content analysis techniques.

Findings

Importantly, the principal investigator observed that although she had anticipated that participants might be uncomfortable being interviewed at such a difficult time, she found that participants were not only comfortable, they appreciated the chance to tell their stories and would have been willing to share even more than was requested. Researchers identified four principal themes from the data analysis: (1) family/friend awareness of nursing vigilance provided them with a sense of being cared for, (2) nursing presence enhanced mutual connectedness and appreciation, (3) when death was imminent, family/friends wanted to understand the process, be included in discussions, and be validated after decisions were made, and (4) attention to the environment of care provided peace and relaxation at a difficult time.

Nursing Implications

Nurses working in end-of-life care need to keep in mind that support for family members and validation of difficult decisions are vital components of their communication. Furthermore, this communication is essential to increase family members' levels of comfort and trust in the entire health care team.

- Avoid the impulse to give advice.
- Avoid canned responses: "I know just how you feel."
- Ask questions.
- Assess understanding—your own and the patient's—by restating, summarizing, and reviewing.

(See the Nursing Research Profile in Chart 59-4.)

Responding with Sensitivity to Difficult Questions

Patients often direct questions or concerns to nurses before they have been able to fully discuss the details of their diagnosis and prognosis with their physicians or the entire health care team. Using open-ended questions allows the nurse to elicit the patient's and family's concerns, explore misconceptions and needs for information, and form the basis for collaboration with physicians and other team members.

For example, a seriously ill patient might ask the nurse, "Am I dying?" The nurse should avoid making unhelpful responses that dismiss the patient's real concerns or defer the issue to another care provider. Nursing assessment and intervention are always possible, even when a need for further discussion with a physician is clearly indicated. Whenever possible, discussions in response to a patient's concerns should occur when the patient expresses a need, although that may be the least convenient time for the nurse. Creating an uninterrupted space of just 5 minutes can do much to identify the source of the concern, allay anxieties, and plan for follow-up.

In response to the question "Am I dying?" the nurse could establish eye contact and follow with a statement acknowledging the patient's fears ("This must be very difficult for you") and an open-ended statement or question ("Tell me more about what is on your mind"). The nurse then needs to listen intently, ask additional questions for clarification, and provide reassurance only when it is realistic. In this example, the nurse might quickly ascertain that the patient's question emanates from a need for specific information—about diagnosis and prognosis from the physician, about the physiology of the dying process from the nurse, or perhaps about financial implications for the family from the social worker.

As a member of the interprofessional team caring for the patient at the end of life, the nurse plays an important role in facilitating the team's understanding of the patient's values and preferences, family dynamics concerning decision making, and the patient's and the family's response to treatment and changing health status. Many dilemmas in patient care at the end of life are related to poor communication between team members and the patient and the family, as well as to failure of team members to communicate with one another effectively. Regardless of the care setting, the nurse can ensure a proactive approach to the psychosocial care of the patient and the family. Periodic, structured assessments provide an opportunity for all parties to consider their priorities and plan for an uncertain future. The nurse can help the patient and the family clarify their values and preferences concerning end-of-life care by using a structured approach. Sufficient time must be devoted to each step so that the patient and the family have time to process new information, formulate questions, and consider their options. The nurse may need to plan several meetings to facilitate communication to accomplish the steps described in Chart 59-3.

Providing Culturally Sensitive Care at the End of Life

Although death, grief, and mourning are universally accepted aspects of living, the values, expectations, and practices during serious illness as death approaches and after death are culturally bound and expressed. Health care providers may share similar values concerning end-of-life care and may find that they are inadequately prepared to assess for and implement care plans that support culturally diverse perspectives. Historical mistrust of the health care system and unequal access to even basic medical care may underlie the beliefs and attitudes among

ethnically diverse populations (see Table 59-1). In addition, lack of education or knowledge about end-of-life care treatment options and language barriers influence decisions among many socioeconomically disadvantaged groups.

The nurse's role is to assess the values, preferences, and practices of every patient, regardless of ethnicity, socioeconomic status, or background. The nurse can share knowledge about a patient's and family's cultural beliefs and practices with the health care team and facilitate the adaptation of the care plan to accommodate these practices. For example, a nurse may find that a male patient prefers to have his eldest son make all of his care decisions. Institutional practices and laws governing informed consent are also rooted in the Western notion of autonomous decision making and informed consent. If a patient wishes to defer decisions to his son, the nurse can work with the team to negotiate informed consent, respecting the patient's right not to participate in decision making and honoring his family's cultural practice.

The nurse should assess and document the patient's and family's specific beliefs, preferences, and practices regarding end-of-life care, preparation for death, and after-death rituals. Chart 59-5 identifies topics that the nurse should cover and questions the nurse may use to elicit the information.

The nurse must use judgment and discretion about the timing and setting for eliciting this information. Some patients may wish to have a family member speak for them or may be unable to provide information because of advanced illness. The nurse should give the patient and the family a context for the discussion, such as

> It is very important to us to provide care that addresses your needs and the needs of your family. We want to honor and support your wishes, and want you to feel free to tell us how we are doing, and what we could do to better meet your needs. I'd like to ask you some questions; what you tell me will help me to understand and support what is most important to you at this time. You don't need to answer anything that makes you uncomfortable. Is it all right to ask some questions?

The assessment of end-of-life beliefs, preferences, and practices should be carried out in short segments over a period of time (e.g., across multiple days of an inpatient hospital stay or in conjunction with multiple patient visits to an outpatient setting or over several home care visits). The discomfort of novice nurses with asking questions and discussing this type of sensitive content can be reduced by prior practice in a classroom or clinical skills laboratory, observation of interviews conducted by experienced nurses, and partnering with experienced nurses during the first few assessments.

Goal Setting in Palliative Care at the End of Life

As treatment goals begin to shift to emphasize comfort care with or in lieu of aggressive disease-focused treatment, symptom relief and patient/family-defined quality of life assume greater prominence in treatment decision making. Throughout the course of the illness, and especially as the patient's functional status and symptoms indicate approaching death, the clinician should help the patient and the family weigh the benefits of continued diagnostic testing and disease-focused medical treatment in the context of their goals for care. The patient and the family may be extremely reluctant to forego monitoring that has become routine throughout the illness (e.g., blood testing, x-rays) but that may contribute little to a primary focus on

Chart 59-5 ASSESSMENT

Assessing End-of-Life Care Beliefs, Preferences, and Practices

Disclosure/truth telling: "Tell me how you/your family talk about very sensitive or serious matters."
- Content: "Are there any topics that you or your family are uncomfortable discussing?"
- Person responsible for disclosure: "Is there one person in the family who assumes responsibility for obtaining and sharing information?"
- Disclosure practices regarding children: "What kind of information may be shared with children in your family, and who is responsible for communicating with the children?"
- Sharing of information within the family or community group: "What kind/how much information should be shared with your immediate family? Your extended family? Others in the community (e.g., members of a religious community)?"

Decision-making style: "How are decisions made in your family? Who would you like to be involved in decisions about your treatment or care?"
- Individual
- Family centered
- Family elder or patriarch/matriarch
- Deference to authority (such as the physician)

Symptom management: "How would you like us to help you to manage the physical effects of your illness?"
- Acceptability of medications used for symptom relief
- Beliefs regarding expression of pain and other symptoms
- Degree of symptom management desired

Life-sustaining treatment expectations: "Have you thought about what type of medical treatment you or your loved one would want as the end of life is nearing? Do you have an advance directive (living will and/or durable power of attorney)?"
- Nutrition/hydration at the end of life
- Cardiopulmonary resuscitation
- Ventilator
- Dialysis
- Antibiotics
- Medications to treat infection

Desired location of dying: "Do you have a preference about being at home or in some other location when you die?"
- Desired role for family members in providing care: "Who do you want to be involved in caring for you at the end of life?"
- Gender-specific prohibitions: "Are you uncomfortable having either males or females provide your care or your loved one's personal care?"

Spiritual/religious practices and rituals: "Is there anything that we should know about your spiritual or religious beliefs about death? Are there any practices that you would like us to observe as death is nearing?"

Care of the body after the death: "Is there anything that we should know about how a body/your body should be treated after death?"

Expression of grief: "What types of losses have you and your family experienced? How do you and your family express grief?"

Funeral and burial practices: "Are there any rituals or practices associated with funerals or burial that are especially important to you?"

Mourning practices: "How have you and your family carried on after a loss in the past? Are particular behaviors or practices expected or required?"

comfort. Likewise, health care providers may have difficulty discontinuing such diagnostic testing or medical treatment.

Specifically, the nurse should collaborate with other members of the interdisciplinary team to share assessment findings, develop a coordinated plan of care, and make decisions about diagnostic testing at the end of life (see Fig. 59-2). In addition, the nurse should help the patient and the family clarify their goals, expected outcomes, and values as they consider treatment options (see Chart 59-6). The nurse should work with colleagues in other disciplines to ensure that the patient and the family are referred for continuing psychosocial support, symptom management, and assistance with other care-related challenges (e.g., arrangements for home care or hospice support, referrals for financial assistance).

Spiritual Care

Attention to the spiritual component of the illness experienced by the patient and the family is not new within the context of nursing care, yet many nurses lack the comfort or skills to assess and intervene in this dimension. Spirituality contains features of religiosity; however, the two concepts are not interchangeable. Spirituality includes domains such as how a person derives meaning and purpose from life, one's beliefs and faith, sources of hope, and attitudes toward death (Puchalski, Vitillo, Hull, et al., 2014). For most people, contemplating one's own death raises many issues, such as the meaning of existence, the purpose of suffering, and the existence of an afterlife. A survey on end-of-life

Chart 59-6 ASSESSMENT

Assessing the Patient and Family Perspective: Goal Setting in Palliative Care

- **Awareness of diagnosis, illness stage, and prognosis:** "Tell me your understanding of your illness right now."
- **Values:** "Tell me what is most important to you as you are thinking about the treatment options available to you/your loved one."
- **Preferences:** "You've said that being comfortable and pain free is most important to you right now. Where would you like to receive care (home, hospital, long-term care facility, doctor's office), and how can I help?"
- **Expected/desired outcomes:** "What are your hopes and expectations for this (diagnostic test [e.g., CT scan] or treatment)?"
- **Benefits and burdens:** "Is there a point at which you would say that the testing or treatment is outweighed by the burdens it is causing you (e.g., getting from home to the hospital, pain, nausea, fatigue, interference with other important activities)?"

CT, computed tomography.

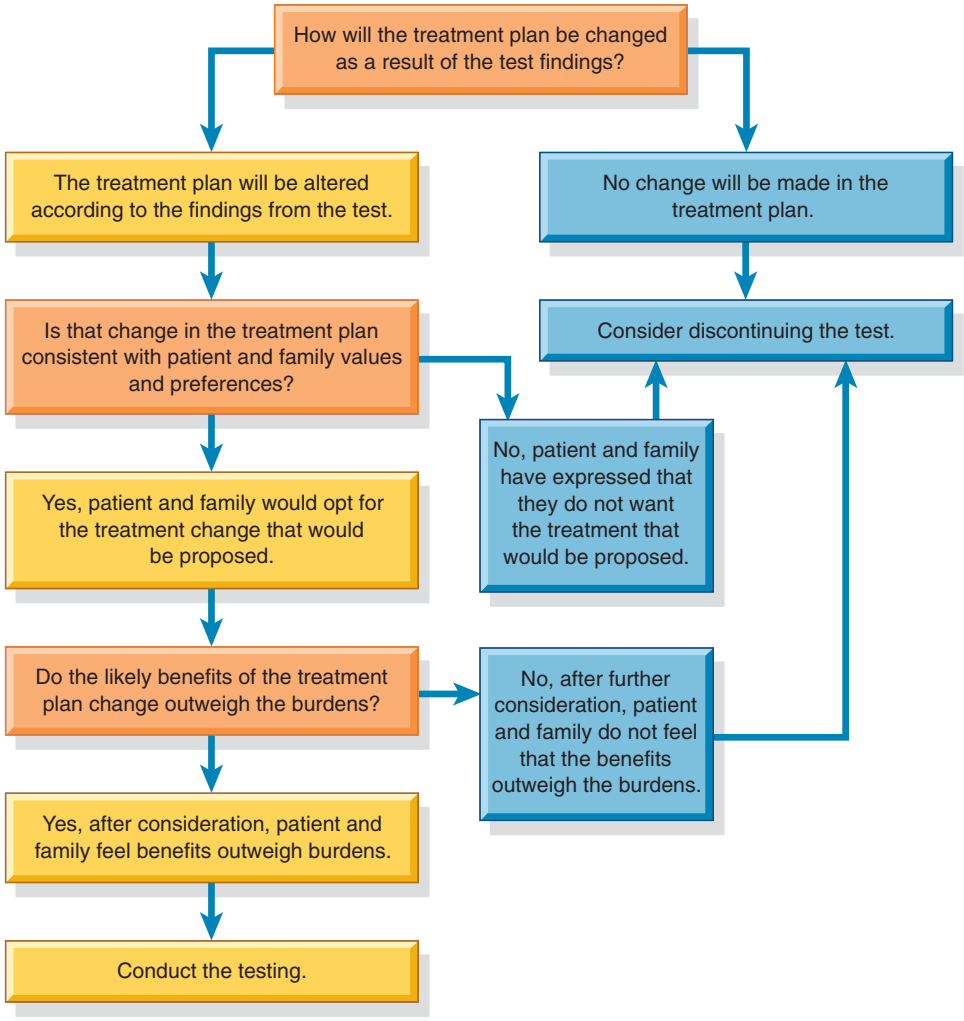


Figure 59-2 • An algorithm for decision making about diagnostic testing at the end of life.

issues conducted by the Pew Research Center (2013) revealed that personal attitudes and preferences concerning end-of-life treatment are related to religious affiliation, race, and ethnicity. The spiritual assessment is a key component of comprehensive nursing assessment for terminally ill patients and their families. Although the nursing assessment should include religious affiliation, spiritual assessment is conceptually much broader than religion and, therefore, is relevant regardless of a patient's expression of religious preference or affiliation. In addition to the assessment of the role of religious faith and practices, important religious rituals, and connection to a religious community (see Table 59-1), the nurse should further explore:

- The harmony or discord between the patient's and the family's beliefs
- Other sources of meaning, hope, and comfort
- The presence or absence of a sense of peace of mind and purpose in life
- Spiritual or religious beliefs about illness, medical treatment, and care of the sick

A four-step spiritual assessment process using the acronym FICA involves asking the following questions (Puchalski & Romer, 2000):

- *F*aith and belief: Do you consider yourself to be a spiritual or religious person? What is your *faith* or belief? What gives your life meaning?
- *I*mportance and *I*nfluence: What *importance* does faith have in your life? Have your beliefs influenced the way you take care of yourself and your illness? What role do your beliefs play in regaining your health?
- *C*ommunity: Are you a part of a spiritual or religious *community*? Is this of support to you and how? Is there a group of people you really love or who are important to you?
- *A*ddress in care: How would you like me to *address* these issues in your health care?

Hope

Clinicians and researchers have observed that although specific hopes may change over time, hope generally persists in some form across every stage of illness. In terminal illness, hope represents the patient's imagined future, forming the basis of a positive, accepting attitude and providing the patient's life with meaning, direction, and optimism. When hope is viewed in this way, it is not limited to cure of the disease; instead, it focuses on what is achievable in the time remaining. Many patients find hope in working on important relationships and creating legacies. Terminally ill patients can be extremely resilient, reconceptualizing hope repeatedly as they approach the end of life.

Numerous nurse researchers have studied the concept of hope, and they have related its presence to spirituality, quality of life, and transcendence (Knabe, 2013). Hope is a multidimensional construct that provides comfort as a person endures life threats and personal challenges. The following are hope-fostering and hope-hindering activities among terminally ill hospice patients with various diagnoses:

- *Hope-fostering categories:* Love of family and friends, spirituality/faith, setting goals and maintaining independence, positive relationships with clinicians, humor, personal characteristics, and uplifting memories
- *Hope-hindering categories:* Abandonment and isolation, uncontrollable pain/discomfort, and devaluation of personhood

Nurses can support hope for the patient and the family by using effective listening and communication skills, thus encouraging realistic hope that is specific to their needs for information, expectations for the future, and values and preferences concerning the end of life. Nurses must engage in self-reflection and identify their own biases and fears concerning illness, life, and death. As nurses become more skilled in working with seriously ill patients, they can become less determined to "fix" and more willing to listen; more comfortable with silence, grief, anger, and sadness; and more fully present with patients and their families.

Nursing interventions for enabling and supporting hope include the following:

- Listening attentively
- Encouraging sharing of feelings
- Providing accurate information
- Encouraging and supporting the patients' control over their circumstances, choices, and environment whenever possible
- Assisting patients to explore ways for finding meaning in their lives
- Encouraging realistic goals
- Facilitating effective communication within families
- Making referrals for psychosocial and spiritual counseling
- Assisting with the development of supports in the home or community when none exist

Managing Physiologic Responses to Terminal Illness

Patients approaching the end of life experience many of the same symptoms, regardless of their underlying disease processes. Symptoms in terminal illness may be caused by the disease, either directly (e.g., dyspnea owing to chronic obstructive lung disease) or indirectly (e.g., nausea and vomiting related to pressure in the gastric area), by the treatment for the disease, or by a coexisting disorder that is unrelated to the disease. Symptoms should be carefully and systematically assessed and managed. Questions that guide the assessment of symptoms are listed in Chart 59-7.

The patient's goals should guide symptom management. Medical interventions may be aimed at treating the underlying causes of the symptoms or reducing the impact of symptoms. For example, a medical intervention such as thoracentesis (an invasive procedure in which fluid is drained from the pleural space) may be performed to temporarily relieve dyspnea in a patient with pleural effusion secondary to lung cancer. Pharmacologic and nonpharmacologic methods of symptom management may be used in combination with medical interventions to modify the physiologic causes of

Chart 59-7 ASSESSMENT

Assessing Symptoms Associated with Terminal Illness

- How is this symptom affecting the patient's life?
- What is the meaning of the symptom to the patient? To the family?
- How does the symptom affect physical functioning, mobility, comfort, sleep, nutritional status, elimination, activity level, and relationships with others?
- What makes the symptom better?
- What makes it worse?
- Is it worse at any particular time of the day?
- What are the patient's expectations and goals for managing the symptom? The family's expectations?
- How is the patient coping with the symptom?
- What is the economic effect of the symptom and its management?

Adapted from Jacox, A., Carr, D. B., & Payne, R. (1994). Management of cancer pain. Rockville, MD: Agency for Health Care Policy and Research.

symptoms. For example, pharmacologic management with low-dose oral morphine effectively relieves dyspnea (Kamal, McGuire, Wheeler, et al., 2012), and mindful breathing can relive distress for patients and families receiving palliative care (Beng, Ahmad, Loong, et al., 2015). As is true with pain, the principles of pharmacologic symptom management are the use of the smallest dose of the medication to achieve the desired effect, avoidance of polypharmacy, anticipation and management of adverse effects, and creation of a therapeutic regimen that is acceptable to the patient based on their goals for maximizing quality of life.

The patient's goals take precedence over the clinicians' goals. Although clinicians may believe that symptoms must be completely relieved whenever possible, the patient might choose instead to decrease symptoms to a tolerable level rather than to relieve them completely if the side effects of medications are unacceptable to him or her. This often allows the patient to have greater independence, mobility, and alertness and to devote attention to issues that he or she considers of higher priority and greater importance.

Anticipating and planning interventions for symptoms is a cornerstone of both palliative and end-of-life care. Patients and family members cope more effectively with new symptoms and exacerbations of existing symptoms when they know what to expect and how to manage them. At the end of life, hospice programs typically provide "emergency kits" containing ready-to-administer doses of various medications that are useful to treat symptoms in advanced illness. For example, a kit might contain small doses of oral morphine liquid for pain or shortness of breath, a benzodiazepine for restlessness, and an acetaminophen/paracetamol suppository for fever. Family members can be instructed to administer a prescribed dose from the emergency kit, often avoiding prolonged suffering for the patient as well as rehospitalization for symptom management.

Pain

In the final stages of illnesses such as cancer, heart disease, COPD, and renal disease, pain and other symptoms are common. Pain results from the diseases as well as the modalities used to treat them. The Worldwide Palliative Care Alliance and World Health Organization (2014) called attention to the continuing, worldwide high prevalence of pain at the end of life and the inadequate supply of opioids, particularly in developing nations. Pain at the end of life is preventable or treatable in most cases: it is every nurse's role to ensure that pain is assessed, prevented where possible, and managed. Chapter 9 presents the importance of pain assessment, assessment principles for pain that include identifying the effect of the pain on the patient's life, and the importance of believing the patient's report of the pain and its effect. Although the means to relieve pain have existed for many years, the continued, pervasive undertreatment of pain has been well documented (Reynolds, Drew, & Dunwoody, 2013). Poorly managed pain affects the psychological, emotional, social, and financial well-being of patients. Despite studies demonstrating the negative effects of inadequate pain management, practice has been slow to change. Every clinician should be able to assess and oversee the basic management of pain (IOM, 2014b).

Patients who are receiving an established regimen of analgesics should continue to receive those medications as they approach the end of life. Inability to communicate pain should not be equated with the absence of pain (McGuire, Reifsnyder, Soeken, et al., 2011). Although most pain can be managed effectively using the oral route, as the end of life nears, patients may be less able to swallow oral medications due to somnolence or nausea. Patients who have been receiving opioids should continue to receive equianalgesic doses via rectal or sublingual routes. Concentrated morphine solution can be effectively delivered by the sublingual route, because the small liquid volume is well tolerated even if swallowing is not possible. As long as the patient continues to receive opioids, a regimen to combat constipation must be implemented. If the patient cannot swallow laxatives or stool softeners, rectal suppositories or enemas may be necessary.

The nurse should educate the family about continuation of comfort measures as the patient approaches the end of life, how to administer analgesics via alternative routes, and how to assess for pain when the patient cannot verbally report pain intensity. Because the analgesics given orally or rectally are short acting and typically scheduled as frequently as every 3 to 4 hours around the clock, there is always a strong possibility that a patient approaching the end of life will die in close proximity to the time of analgesic administration. If the patient is at home, family members administering analgesics should be prepared for this possibility. They need reassurance that they did not "cause" the death of the patient by administering a dose of analgesic medication.

Dyspnea

Dyspnea, an uncomfortable awareness of breathing, is one of the most prevalent symptoms at the end of life and can be challenging to manage (Kamal et al., 2012). A highly subjective symptom, dyspnea often is not associated with visible signs of distress, such as tachypnea, diaphoresis, or cyanosis. Although the underlying cause of the dyspnea can be identified and treated in some cases, the burdens of additional diagnostic evaluation and treatment aimed at the physiologic problem may outweigh the benefits. The treatment of dyspnea varies depending on the underlying cause, the patient's general physical condition, and imminence of death. For example, a blood transfusion may provide temporary symptom relief for a patient with anemia earlier in the disease process; however, as the patient approaches the end of life, the benefits are typically short-lived or absent.

Nursing Assessment

As with assessment of pain, reports of dyspnea by patients must be believed. As is true for physical pain, the meaning of dyspnea to an individual patient may increase their suffering. For example, the patient may interpret increasing dyspnea as a sign that death is approaching. For some patients, sensations of breathlessness may invoke frightening images of drowning or suffocation, and the resulting cycle of fear and anxiety may increase the sensation of breathlessness. Therefore, the nurse should conduct a careful assessment of the psychosocial and spiritual components of the dyspnea. Physical assessment parameters include symptom intensity, distress, and interference with activities; auscultation of lung sounds; assessment of fluid balance, including measurement of dependent edema (circumference of lower extremities) and abdominal girth; temperature; skin color; sputum quantity and character; and cough.

To determine the intensity of dyspnea and its interference with daily activities, the patient can be asked to report the severity of the dyspnea using a scale of 0 to 10, where 0 is no dyspnea and 10 is the worst imaginable dyspnea. The nurse should assess the patient's baseline rating before treatment and should elicit subsequent measurements taken during exacerbation of the symptom, periodically during treatment,

and whenever the treatment plan changes; these parameters provide ongoing objective evidence for the efficacy of the treatment plan. In addition, physical assessment findings may assist in locating the source of the dyspnea and selecting nursing interventions to relieve the symptom. The components of the assessment change as the patient's condition changes. For example, when the patient who has been on daily weights can no longer get out of bed, the goal of comfort may outweigh the benefit of continued weights. Like other symptoms at the end of life, dyspnea can be managed effectively in the absence of assessment and diagnostic data (e.g., arterial blood gases) that are standard when a patient's illness or symptom is acute and considered reversible. A numeric rating scale similar to one that is used for assessing pain can provide objective evidence of the severity of the patient's dyspnea.

Nursing Management

Nursing management of dyspnea at the end of life is directed toward administering medical treatment for the underlying pathology, monitoring the patient's response to treatment, helping the patient and the family manage anxiety (which exacerbates dyspnea), altering the perception of the symptom, and conserving energy (see Chart 59-8). Pharmacologic intervention is aimed at modifying lung physiology and improving performance as well as altering the perception of the symptom. Bronchodilators and corticosteroids are used to treat underlying obstructive pathology, thereby improving overall lung function. Low doses of opioids effectively relieve dyspnea, although the mechanism of relief is not entirely clear. Although dyspnea in terminal illness is typically not associated with diminished blood oxygen saturation, low-flow oxygen often provides psychological comfort to both patients and families, particularly in the home setting.

As mentioned previously, dyspnea may be exacerbated by anxiety, and anxiety may trigger episodes of dyspnea, setting off a respiratory crisis in which the patient and the family may panic. For patients receiving care at home, patient and family education should include anticipation and management of crisis situations and a clearly communicated emergency plan. The patient and the family should be instructed about medication administration, condition changes that should be reported to the physician and the nurse, and strategies for coping with diminished reserves and increasing symptomatology as the disease progresses. The patient and the family require reassurance that the symptom can be effectively managed at home without the need for activation of the emergency medical services or hospitalization and that a nurse will be available at all times via telephone and to make a visit.

Chart 59-8

Palliative Nursing Interventions for Dyspnea

Decrease Anxiety

- Administer prescribed anxiolytic medications as indicated for anxiety or panic associated with dyspnea.
- Assist with relaxation techniques, guided imagery.
- Provide patient with a means to call for assistance (call bell/light within reach in a hospital or long-term care facility; handheld bell or other device for home).

Treat Underlying Pathology

- Administer prescribed bronchodilators and corticosteroids (obstructive pathology).
- Administer blood products, erythropoietin as prescribed (typically not beneficial in advanced disease).
- Administer prescribed diuretics and monitor fluid balance.

Alter Perception of Breathlessness

- Administer prescribed oxygen therapy via nasal cannula, if tolerated; masks may not be well tolerated.
- Administer prescribed low-dose opioids via oral route (morphine sulfate is used most commonly).
- Provide air movement in the patient's environment with a portable fan.

Reduce Respiratory Demand

- Educate patient and family to implement energy conservation measures.
- Place needed equipment, supplies, and nourishment within reach.
- For home or hospice care, offer bedside commode, electrical bed (with head that elevates).

Nutrition and Hydration at the End of Life

Anorexia and cachexia are common in the seriously ill. The profound changes in the patient's appearance and a lack of interest in the socially important rituals of mealtime are particularly disturbing to families. The approach to the problem varies depending on the patient's stage of illness, level of disability associated with the illness, and desires. The anorexia–cachexia syndrome is characterized by disturbances in carbohydrate, protein, and fat metabolism; endocrine dysfunction; and anemia. The syndrome results in severe asthenia (loss of energy).

Anorexia and cachexia differ from starvation (simple food deprivation) in several important ways. Appetite is lost early in the process, the body becomes catabolic in a dysfunctional way, and supplementation by gastric feeding (tube feeding) or parenteral nutrition in advanced disease does not replenish lean body mass that has been lost.

Anorexia

Although causes of anorexia may be controlled for a period of time, progressive anorexia is an expected and natural part of the dying process. Anorexia may be related to or exacerbated by situational variables (e.g., the ability to have meals with the family vs. eating alone in the "sick room"), progression of the disease, treatment of the disease, or psychological distress. The patient and the family should be instructed in strategies to manage the variables associated with anorexia (see Table 59-2).

Use of Pharmacologic Agents to Stimulate Appetite

Several pharmacologic agents are commonly used to stimulate appetite in patients with anorexia, although only progestational agents (e.g., megestrol acetate [Megace]) and glucocorticoids (e.g., dexamethasone [Dexpak]) have been found to stimulate appetite when examined in well-controlled research studies (Bondly & Jatoi, 2015). However, these agents have not been found to improve survival or quality in life in patients approaching end of life (Arensmeyer, 2012). Dexamethasone initially increases appetite and may provide short-term weight gain in some patients. It should be considered for those patients whose life expectancy is limited because the beneficial effects may be limited to the first few weeks of therapy and side effects increase over time (Del Fabbro, 2015). Therapy may need to be discontinued in patients with a longer life expectancy; after 3 to 4 weeks, corticosteroids interfere with the synthesis of muscle protein.

TABLE 59-2 Measures for Managing Anorexia

Nursing Interventions	Patient and Family Education Tips
Initiate measures to ensure adequate dietary intake without adding stress to the patient at mealtimes.	Reduce the focus on "balanced" meals; offer the same food as often as the patient desires it.
Assess the impact of medications (e.g., chemotherapy, antiretrovirals) or other therapies (radiation therapy, dialysis) that are being used to treat the underlying illness.	Increase the nutritional value of meals. For example, add dry milk powder to milk, and use this fortified milk to prepare cream soups, milkshakes, and gravies.
Administer and monitor effects of prescribed treatment of nausea, vomiting, and delayed gastric emptying.	
Encourage patient to eat when effects of medications have subsided.	Allow and encourage the patient to eat when hungry, regardless of usual mealtimes.
Assess and modify environment to eliminate unpleasant odors and other factors that cause nausea, vomiting, and anorexia.	Eliminate or reduce noxious cooking odors, pet odors, or other odors that may precipitate nausea, vomiting, or anorexia.
Remove items that may reduce appetite (soiled tissues, bedpans, emesis basins, clutter).	Keep patient's environment clean, uncluttered, and comfortable.
Assess and manage anxiety and depression to the extent possible.	Make mealtime a shared experience away from the "sick" room whenever possible. Reduce stress at mealtimes. Avoid confrontations about the amount of food consumed. Reduce or eliminate routine weighing of the patient.
Position to enhance gastric emptying.	Encourage patient to eat in a sitting position; elevate the head of the patient's bed. Plan meals (food selection and portion size) that the patient desires. Provide small frequent meals if they are easier for patient to eat.
Assess for constipation and/or intestinal obstruction.	Ensure that patient and family understand that prevention of constipation is essential, even when the patient's intake is minimal.
Prevent and manage constipation on an ongoing basis, even when the patient's intake is minimal.	Encourage adequate fluid intake, dietary fiber, and the use of a bowel program to prevent constipation.
Provide frequent mouth care, particularly following nourishment.	Assist the patient to rinse after every meal. Avoid mouthwashes that contain alcohol or glycerine, which dry mucous membranes.
Ensure that dentures fit properly.	Weight loss may cause dentures to loosen and cause irritation. Remove them to inspect the gums and to provide oral care.
Administer and monitor effects of topical and systemic treatment for oropharyngeal pain.	The patient's comfort may be enhanced if medications for pain relief given on an as-needed basis for breakthrough pain are given before mealtimes.

Megestrol acetate produces temporary weight gain of primarily fatty tissue, with little effect on protein balance. This agent carries risk of serious side effects, including thromboembolism, and risk increases with prolonged use (Del Fabbro, 2015).

Dronabinol is a psychoactive compound found in cannabis that may be helpful in reducing nausea and vomiting, appetite loss, pain, and anxiety, thereby improving food and fluid intake in some patients. However, in most patients, it is not as effective as other agents for appetite stimulation. Although dronabinol may have beneficial effects on appetite in patients with advanced cancer, it has not been shown to be more effective than megestrol. In addition, it possesses undesirable central nervous system side effects (Del Fabbro, 2015).

Cachexia

Cachexia refers to severe lean muscle loss with or without fat loss that cannot be reversed by traditional nutritional interventions (Fearon, Strasser, Anker, et al., 2011). Although anorexia may exacerbate cachexia, it is not the primary cause. Cachexia is associated with anabolic and catabolic changes in metabolism that relate to activity of neurohormones and proinflammatory cytokines, resulting in profound protein loss. These processes appear to be similar at the end stages of both cancer and some noncancerous illnesses, such as AIDS (Del Fabbro, 2015). However, the pathophysiology of cachexia in terminal illness is not well understood. In terminal illness, the severity of tissue wasting is greater than would be expected from reduced food intake alone, and typically increasing appetite or food intake does not reverse cachexia.

At one time, it was believed that patients with cancer with rapidly growing tumors developed cachexia because the tumor created an excessive nutritional demand and diverted nutrients from the rest of the body. Research links cytokines produced by the body in response to a tumor to a complex inflammatory-immune response present in patients whose tumors have metastasized, leading to anorexia, weight loss, and altered metabolism. An increase in cytokines occurs not only in cancer but also in AIDS and many other chronic diseases (Del Fabbro, 2015).

Artificial Nutrition and Hydration

Along with breathing, eating and drinking are essential to survival throughout life. Near the end of life, the body's nutritional needs change, and the desire for food and fluid may diminish. People may no longer be able to use, eliminate, or store nutrients and fluids adequately. Eating and sharing meals are important social activities in families and communities, and

food preparation and enjoyment are linked to happy memories, strong emotions, and hope for survival. For patients with serious illness, food preparation and mealtimes often become battlegrounds in which well-meaning family members argue, plead, and cajole to encourage ill people to eat. Seriously ill patients often lose their appetites entirely, develop strong aversions to foods that they have enjoyed in the past, or crave a particular food to the exclusion of all other foods.

Although nutritional supplementation may be an important part of the treatment plan in early or chronic illness, unintended weight loss and dehydration are expected characteristics of progressive illness. As illness progresses, patients, families, and clinicians may believe that without artificial nutrition and hydration, terminally ill patients will "starve," causing profound suffering and hastened death. However, starvation should not be viewed as the failure to insert tubes for nutritional supplementation or hydration of terminally ill patients with irreversible progression of disease. Research has demonstrated that terminally ill patients with cancer who were hydrated did not have improved biochemical parameters and exhibited lower serum albumin levels, leading to fluid retention. The use of artificial nutrition and hydration (tube and intravenous [IV] fluids and feeding) carries considerable risks and generally does not contribute to comfort at the end of life (Casarett, Kapo, & Kaplan, 2005). Similarly, survival is not increased when terminally ill patients with advanced dementia receive enteral feeding, and no data support an association between tube feeding and improved quality of life in these patients (Mitchell, Black, Ersek, et al., 2012). Furthermore, in patients who are close to death, symptoms associated with dehydration such as dry mouth, confusion, and diminished alertness are common and typically do not respond to artificial nutrition (Danis, Arnold, & Savarese, 2015). Dry mouth can generally be managed through nursing measures such as mouth care and environmental changes with medications to diminish confusion.

As the patient approaches the end of life, the family and the health care providers should offer the patient what he or she prefers and can most easily tolerate. The nurse should instruct the family how to separate feeding from caring and how to demonstrate love, sharing, and caring by being with the loved one in other ways. Preoccupation with appetite, feeding, and weight loss diverts energy and time that the patient and the family could use in other meaningful activities. In addition to those given in Table 59-2, the following are the tips to promote nutrition for terminally ill patients:

- Offer small portions of favorite foods.
- Be aware that cool foods may be better tolerated than hot foods.
- Offer cheese, eggs, peanut butter, mild fish, chicken, or turkey. Meat (especially beef) may taste bitter and unpleasant.
- Add milk shakes, meal replacement drinks, or other liquid supplements.
- Place nutritious foods at the bedside (fruit juices, milk shakes in insulated drink containers with straws).
- Schedule meals when family members can be present to provide company and stimulation.
- Offer ice chips made from frozen fruit juices.
- Allow the patient to refuse foods and fluids.

Delirium

Many patients remain alert, arousable, and able to communicate until very close to death. Others sleep for long intervals and awaken only intermittently, with eventual somnolence until death. Delirium refers to concurrent disturbances in the level of consciousness, attention, awareness, and cognitive capability that develop over a relatively short period of time (Wright, Brajtman, & Macdonald, 2014). In some patients, a period of agitated delirium precedes death, sometimes causing families to be hopeful that suddenly active patients may be getting better. Confusion may be related to underlying, treatable conditions such as medication side effects or interactions, pain or discomfort, hypoxia or dyspnea, or a full bladder or impacted stool. In patients with cancer, confusion may be secondary to brain metastases. Delirium may also be related to metabolic changes, infection, and organ failure.

Patients with delirium may become hypoactive or hyperactive, restless, irritable, and fearful. Sleep deprivation and hallucinations may occur. If treatment of the underlying factors contributing to these symptoms brings no relief, a combination of pharmacologic intervention with neuroleptics or benzodiazepines may be effective in decreasing distressing symptoms for some patients. There have been few randomized clinical trials to establish evidence for practice, nor are there current clinical guidelines for delirium management (Lawlor & Bush, 2014). The neuroleptic drug haloperidol (Haldol) is the most frequently used drug to treat delirium in palliative care settings and may reduce hallucinations and agitation at the end of life. Newer (atypical) neuroleptics, such as olanzapine (Zyprexa), quetiapine (Seroquel), and risperidone (Risperdal) have been less well studied (Lawlor & Bush, 2014). Benzodiazepines (e.g., lorazepam [Ativan]) can reduce anxiety but may contribute to worsening cognitive impairment if used alone.

Nursing interventions are aimed at identifying the underlying causes of delirium; acknowledging the family's distress over its occurrence; reassuring family members about what is normal; educating family members how to interact with and ensure safety for the patient with delirium; and monitoring the effects of medications used to treat severe agitation, paranoia, and fear. Confusion may mask the patient's unmet spiritual needs and fears about dying. Spiritual intervention, music therapy, gentle massage, and therapeutic touch may provide some relief. Reduction of environmental stimuli, avoidance of harsh lighting or very dim lighting (which may produce disturbing shadows), presence of familiar faces, and gentle reorientation and reassurance are also helpful.

Depression

Clinical depression should neither be accepted as an inevitable consequence of dying nor confused with sadness and anticipatory grieving, which are normal reactions to the losses associated with impending death. Emotional and spiritual support and control of disturbing physical symptoms are appropriate interventions for situational depression associated with terminal illness. Researchers have linked the psychological effects of cancer pain to suicidal thought and, less frequently, to carrying out a planned suicide (Robson, Scrutton, Wilkinson, et al., 2010). Patients and their families must be given space and time to experience sadness and to grieve; however, patients should not have to endure untreated depression at the end of their lives. An effective combined approach to clinical depression includes relief of physical symptoms, attention to emotional and spiritual distress, psychotherapy, and pharmacologic intervention with psychostimulants and antidepressants (Marks & Heinrich, 2013).

Palliative Sedation at the End of Life

Effective control of symptoms can be achieved under most conditions; however, some patients may experience distressing,

intractable symptoms. Although palliative sedation remains controversial, it is offered in some settings to patients who are close to death or who have symptoms that do not respond to conventional pharmacologic and nonpharmacologic approaches, resulting in unrelieved suffering. Palliative sedation is distinguished from euthanasia and physician-assisted suicide, which is not legal in India, in that the intent of palliative sedation is to relieve symptoms, not to hasten death. Palliative sedation is most commonly used when the patient exhibits intractable pain, dyspnea, seizures, or delirium, and it is generally considered appropriate in only the most difficult situations. Before implementing palliative sedation, the health care team should assess for the presence of underlying and treatable causes of suffering, such as depression or spiritual distress. Finally, the patient and the family should be fully informed about the use of this treatment and alternatives. Whereas proportionate palliative sedation uses the minimum drug necessary to relieve the symptom while preserving consciousness, palliative sedation induces unconsciousness, which is more controversial.

Palliative sedation is accomplished through an infusion of one or more pharmacologic agents in doses adequate to eliminate signs of discomfort and, in some cases, induce sleep. In a review of published guidelines for pharmacologic management of palliative sedation, researchers reported that although most published guidelines varied considerably, most mentioned the use of midazolam (Versed), a short-acting hypnotic sedative (Schildmann, Schildmann, & Kiesewetter, 2015). Nurses act as collaborating members of the interdisciplinary health care team, providing emotional support to patients and families, facilitating clarification of values and preferences, and providing comfort-focused physical care. Once sedation has been induced, the nurse should continue to comfort the patient, monitor the physiologic effects of the sedation, support the family during the final hours or days of their loved one's life, and ensure communication within the health care team and between the team and the family.

Nursing Care of Patients who are Close to Death

Providing care to patients who are close to death and being present at the time of death can be one of the most rewarding experiences a nurse can have. Patients and their families are understandably fearful of the unknown, and the approach of death may prompt new concerns or cause previous fears or issues to resurface. Family members who have always had difficulty communicating or who are part of families in which there are old resentments and hurts may experience heightened difficulty as their loved one nears death. However, the time at the end of life can also afford opportunities to resolve old hurts and learn new ways of being a family. Regardless of the setting, skilled practitioners can make dying patients comfortable, make space for their loved ones to remain present if they wish, and can give family members the opportunity to experience growth and healing. Likewise, patients and family members may be less apprehensive near the time of death if they know what to expect and how to respond.

Expected Physiologic Changes

As death approaches and organ systems begin to fail, observable, expected changes in the body take place. Nursing care measures aimed at patient comfort, such as pain medications (given rectally or sublingually), turning, mouth care, eye care, positioning to facilitate draining of secretions, and measures to protect the skin from urine or feces (if the patient is incontinent), should be continued. The nurse should consult with the interprofessional team about discontinuing measures that no longer contribute to patient comfort, such as drawing blood, administering tube feedings, suctioning (in most cases), and invasive monitoring. The nurse should prepare the family for the normal, expected changes that accompany the period immediately preceding death. Although the exact time of death cannot be predicted, it is often possible to identify when the patient is very close to death. Hospice programs frequently provide written information for families so that they know what to expect and what to do as death nears (see Chart 59-9).

If family members have been prepared for the time of death, they are less likely to panic and are better able to be with their loved one in a meaningful way. Noisy, gurgling breathing or moaning is generally most distressing to family members. In most cases, the sounds of breathing at the end of life are related to oropharyngeal relaxation and diminished awareness. Family members may have difficulty believing that the patient is not in pain or that the patient's breathing could not be improved by suctioning secretions. Patient positioning and family reassurance are the most helpful responses to these symptoms.

When death is imminent, patients may become increasingly somnolent and unable to clear sputum or oral secretions, which may lead to further impairment of breathing from pooled or dried and crusted secretions. The sound (terminal bubbling) and appearance of the secretions are often more distressing to family members than is the presence of the secretions to the patient. Family distress over the changes in the patient's condition may be eased by supportive nursing care. Continuation of comfort-focused interventions and reassurance that the patient is not in any distress can do much to ease family concerns. Gentle mouth care with a moistened swab or very soft toothbrush helps maintain the integrity of the patient's mucous membranes. In addition, gentle oral suctioning, positioning to enhance drainage of secretions, and sublingual or transdermal administration of anticholinergic drugs (see Table 59-3) reduce the production of secretions and provide comfort to the patient

TABLE 59-3 Secretions and Terminal Respiratory Congestion

Medication	Suggested Initial Dosing
Atropine 1% ophthalmic (Isopto-Atropine®)	1 to 2 drops PO/SL every 4 hours, scheduled or PRN
Atropine injection[a]	0.4 mg IV/SC/IM every 4 hours, scheduled or PRN
Glycopyrrolate[a] (Robinul®)	1 mg PO TID, scheduled or PRN, up to 6 mg/d, or 0.1 mg SC/IM/IV TID PRN or
Hyoscyamine[a] (Levsin®)	0.125 mg PO/SL every 4 hours PRN, up to 1.5 mg/d
Hyoscyamine extended-release[a] (Levbid®)	0.375 mg PO every 12 hours, up to 1.5 mg/d
Scopolamine (Transderm Scop®)	Apply 1 patch topically behind the ear every 72 hours, up to 3 patches/72 hours

IM, intramuscularly; IV, intravenously; PO, by mouth; PRN, as needed; SC, subcutaneously; SL, sublingually; TID, twice a day.
[a]Preferred agent(s).
Reprinted with permission from Enclara Pharmacia, Inc. (2015). Enclara Pharmacia Medication Use Guidelines (1st ed.). Philadelphia, PA: Author.

Chart 59-9 EDUCATING THE FAMILY

Signs of Approaching Death

The person shows less interest in eating and drinking. For many patients, refusal of food is an indication that they are ready to die. Fluid intake may be limited to that which will keep their mouths from feeling too dry.

- *What you can do:* Offer, but do not force, fluids and medication. Sometimes pain or other symptoms that have required medication in the past may no longer be present. For most patients, pain medications are still needed, and they can be provided by concentrated oral solutions placed under the tongue or by rectal suppository.

Urinary output may decrease in amount and frequency.

- *What you can do:* No response is needed unless the patient expresses a desire to urinate and cannot. Call the hospice nurse for advice if you are not sure.

As the body weakens, the patient will sleep more and begin to detach from the environment. He or she may refuse your attempts to provide comfort.

- *What you can do:* Allow your loved one to sleep. You may wish to sit with him or her, play soft music, or hold hands. Your loved one's withdrawal is normal and is not a rejection of your love.

Mental confusion may become apparent. This occurs because less oxygen is available to supply the brain. The patient may report strange dreams or visions.

- *What you can do:* As he or she awakens from sleep, remind him or her of the day and time, where he or she is, and who is present. This is best done in a casual, conversational way.

Vision and hearing may become somewhat impaired, and speech may be difficult to understand.

- *What you can do:* Speak clearly but no more loudly than necessary. Keep the room as light as the patient wishes, even at night. Carry on all conversations as if they can be heard, because hearing may be the last of the senses to cease functioning.
- Many patients are able to talk until minutes before death and are reassured by the exchange of a few words with a loved one.

Secretions may collect in the back of the throat and rattle or gurgle as the patient breathes through the mouth. He or she may try to cough, and their mouth may become dry and encrusted with secretions.

- *What you can do:* If the patient is trying to cough up secretions and is experiencing choking or vomiting, call the hospice nurse for assistance.
- Secretions may drain from the mouth if you place the patient on their side and provide support with pillows.
- Cleansing the mouth with moistened mouth swabs will help relieve the dryness that occurs with mouth breathing.
- Offer water in small amounts to keep the mouth moist. A straw with one finger placed over the end can be used to transfer sips of water to the patient's mouth.

Breathing may become irregular with periods of no breathing (apnea). The patient may be working very hard to breathe and may make a moaning sound with each breath. As the time of death nears, the breathing remains irregular and may become more shallow and mechanical.

- *What you can do:* Raising the head of the bed may help the patient to breathe more easily. The moaning sound does not mean that the patient is in pain or other distress; it is the sound of air passing over very relaxed vocal cords.

As the oxygen supply to the brain decreases, the patient may become restless. It is not unusual to pull at the bed linens, to have visual hallucinations, or even to try to get out of bed at this point.

- *What you can do:* Reassure the patient in a calm voice that you are there. Prevent him or her from falling by trying to get out of bed. Soft music or a back rub may be soothing.

The patient may feel hot one moment and cold the next as the body loses its ability to control temperature. As circulation slows, the arms and legs may become cool and bluish. The underside of the body may darken. It may be difficult to feel a pulse at the wrist.

- *What you can do:* Provide and remove blankets as needed. Avoid using electrical blankets, which may cause burns because the patient cannot tell you if he or she is too warm.
- Sponge the patient's head with a cool cloth if this provides comfort.

Loss of bladder and bowel control may occur around the time of death.

- *What you can do:* Protect the mattress with waterproof padding, and change the padding as needed to keep the patient comfortable.

As people approach death, many times they report seeing gardens, libraries, or family or friends who have died. They may ask you to pack their bags and find tickets or a passport. Sometimes they may become insistent and attempt to do these chores themselves. They may try getting out of bed (even if they have been confined to bed for a long time) so that they can "leave."

- *What you can do:* Reassure the patient that it is all right; he or she can "go" without getting out of bed. Stay close, share stories, and be present.

Used with permission from the Hospice of Philadelphia. (2015). Signs of approaching death. Philadelphia, PA: Author.

and support to the family. Deeper suctioning may cause significant discomfort to the dying patient and is rarely of any benefit because secretions reaccumulate rapidly.

The Death Vigil

Although each death is unique, it is often possible for experienced clinicians to assess that the patient is "actively" or imminently dying and to prepare the family in the final days or hours leading to death. As death nears, the patient may withdraw, sleep for longer intervals, or become somnolent. Death is generally preceded by a period of gradual diminishment of bodily functions, increased intervals between respirations, a weakened and irregular pulse, diminished blood pressure, and skin color changes or mottling. Family members should be encouraged to be with the patient, to speak and reassure the patient of their presence, to stroke or touch the patient, or to lie alongside the patient (even in the hospital or long-term care facility) if the family members are comfortable with this degree of closeness and can do so without causing discomfort to the patient.

The family may go to great lengths to ensure that their loved one will not die alone. However, despite the best intentions and efforts of the family and clinicians, the patient may die at a time when no one is present. In any setting, it is unrealistic for family members to be at the patient's bedside 24 hours a day. Experienced hospice clinicians have observed and reported that some patients appear to "wait" until family members are away from the bedside to die, perhaps to spare their loved ones the pain of being present at the time of death. Nurses can reassure family members throughout the death vigil by being present intermittently or continuously, modeling behaviors (such as touching and speaking to the patient), providing encouragement in relation to family caregiving, providing reassurance about normal physiologic changes, and encouraging

family rest breaks. If a patient dies while family members are away from the bedside, they may express feelings of guilt and profound grief and may need emotional support.

After-Death Care

For patients who have received adequate management of symptoms and for families who have received adequate preparation and support, the actual time of death is commonly peaceful and occurs without struggle. Nurses may or may not be present at the time of a patient's death. In many states, nurses are authorized to make the pronouncement of death and sign the death certificate when death is expected. Death is defined as the permanent cessation of respiratory and circulatory functions (Bernat, 2009). The determination of death is made through a physical examination that includes auscultation for the absence of breathing and heart sounds. Home care or hospice programs in which nurses make the time-of-death visit and pronounce death have policies and procedures to guide the nurse's actions during this visit. Immediately on cessation of vital functions, the body begins to change. It becomes dusky or bluish, waxen appearing, and cool; blood darkens and pools in dependent areas of the body (e.g., the back and the sacrum if the body is in a supine position); and urine and stool may be evacuated.

Immediately after death, family members should be allowed and encouraged to spend time with the deceased. Normal responses of family members at the time of death vary widely and range from quiet expressions of grief to overt expressions that include wailing and prostration. The family members' desire for privacy during their time with the deceased should be honored. Family members may wish to independently manage or assist with care of the body after death. In the home, after-death care of the body frequently includes culturally specific rituals such as bathing the body. Home care agencies and hospices vary in the policies surrounding removal of tubes. In the absence of specific guidance from the organization, the nurse should shut off infusions of any kind (IV or tube feeding) and leave IV access devices, feeding tubes, catheters, and wound dressings in place. When an expected death occurs in the home setting, the family generally will have received assistance with funeral arrangements in advance of the death. The funeral home has often been prearranged and the family and friends will transport the body directly to the funeral home. In the hospital or long-term care facility, nurses follow the facility's procedure for preparation of the body and transportation to the facility's morgue. However, the needs of families to remain with the deceased, to wait until other family members arrive before the body is moved, and to perform after-death rituals should be honored.

Some patients may have elected to donate tissue such as corneas, bone, veins, or heart valves for transplant. Typically, this information would be known to the care team before the patient dies. In some cases, such as late referral or an unexpectedly rapid progression, the patient's wishes with respect to donation might be unknown. If the patient died at home or in a nursing home and the deceased's wishes are known, a team member should contact the organ procurement organization through which the deceased had arranged to donate tissue. That organization will ordinarily transport the body for tissue procurement and to the funeral home.

Grief, Mourning, and Bereavement

A wide range of feelings and behaviors are normal, adaptive, and healthy reactions to the loss of a loved one. Grief refers to the personal feelings that accompany an anticipated or actual loss. Mourning refers to individual, family, group, and cultural expressions of grief and associated behaviors. Bereavement refers to the period of time during which mourning for a loss takes place. Both grief reactions and mourning behaviors change over time as people learn to live with the loss. Although the pain of the loss may be tempered by the passage of time, loss is an ongoing developmental process, and time does not heal the bereaved individual completely. That is, the bereaved do not get over a loss entirely, nor do they return to who they were before the loss. Rather, they develop a new sense of who they are and where they fit in a world that has changed dramatically and permanently.

Anticipatory Grief and Mourning

Denial, sadness, anger, fear, and anxiety are normal grief reactions in people with life-threatening illness and those close to them. Kübler-Ross (1969) described five common emotional reactions to dying that are applicable to the experience of any loss (see Table 59-4). Not every patient or family member experiences every stage; many patients never reach a stage of acceptance, and patients and families sometimes fluctuate on a daily basis in their emotional responses. Furthermore, although impending loss stresses the patient, the people who are close to him or her, and the functioning of the family unit, awareness of dying also provides a unique opportunity for family members to reminisce, resolve relationships, plan for the future, and say goodbye.

Individual and family coping with the anticipation of death is complicated by the varied and conflicting trajectories that grief and mourning may assume in families. For example, the patient may be experiencing sadness while contemplating role changes that have been brought about by the illness, and the patient's spouse or partner may be expressing or suppressing feelings of anger about the current changes in role and impending loss of the relationship. Others in the family may be engaged in denial (e.g., "Dad will get better. He just needs to eat more"), fear ("Who will take care of us?" or "Will I get sick, too?"), or profound sadness and withdrawal. Although each of these behaviors is normal, tension may arise when one or more family members perceive that others are less caring, too emotional, or too detached.

The nurse should assess the characteristics of the family system and intervene in a manner that supports and enhances the cohesion of the family unit. Parameters for assessing the family facing life-threatening illness are identified in Chart 59-10. The nurse can suggest that family members talk about their feelings and understand them in the broader context of anticipatory grief and mourning. Acknowledging and expressing feelings, continuing to interact with the patient in meaningful ways, and planning for the time of death and bereavement are adaptive family behaviors. Professional support provided by grief counselors, whether in the community, at a local hospital, in the long-term care facility, or associated with a hospice program, can help both the patient and the family sort out and acknowledge feelings and make the end of life as meaningful as possible.

Grief and Mourning After Death

When a loved one dies, family members enter a new phase of grief and mourning as they begin to accept the loss, feel the pain of permanent separation, and prepare to live a life without the deceased. Even if the loved one died after a long illness, preparatory grief experienced during the terminal illness does not preclude the grief and mourning that follow the death. With a death after a long or difficult illness, family members may experience conflicting feelings of relief that the

TABLE 59-4 Kübler-Ross's Five Stages of Grief

Stage	Nursing Implications
Denial: "This cannot be true." Feelings of isolation. May search for another health care professional who will give a more favorable opinion. May seek unproven therapies.	Denial can be an adaptive response, providing a buffer after bad news. It allows time to mobilize defenses but can be maladaptive when it prevents the patient or the family from seeking help or when denial behaviors cause more pain or distress than the illness or interfere with everyday functions. Nurses should assess the patient's and family's coping style, information needs, and understanding of the illness and treatment to establish a basis for empathetic listening, education, and emotional support. Rather than confronting the patient with information that he or she is not ready to hear, the nurse can encourage him or her to share fears and concerns. Open-ended questions or statements such as "Tell me more about how you are coping with this new information about your illness" can provide a springboard for expression of concerns.
Anger: "Why me?" Feelings of rage, resentment, or envy directed at God, health care professionals, family, others.	Anger can be very isolating, and loved ones or clinicians may withdraw. Nurses should allow the patient and family to express anger, treating them with understanding, respect, and knowledge that the root of the anger is grief over impending loss.
Bargaining: "I just want to see my grandchild's birth, then I'll be ready…." Patient and/or family plead for more time to reach an important goal. Promises are sometimes made with God.	Terminally ill patients are sometimes able to outlive prognoses and achieve some future goal. Nurses should be patient, allow expression of feelings, and support realistic and positive hope.
Depression: "I just don't know how my kids are going to get along after I'm gone." Sadness, grief, mourning for impending losses.	Normal and adaptive response. Clinical depression should be assessed and treated when present. Nurses should encourage the patient and the family to fully express their sadness. Insincere reassurance or encouragement of unrealistic hopes should be avoided.
Acceptance: "I've lived a good life, and I have no regrets." Patient and/or family are neither angry nor depressed.	The patient may withdraw as their circle of interest diminishes. The family may feel rejected by the patient. Nurses need to support the family's expression of emotions and encourage them to continue to be present for the patient.

Adapted from Kübler-Ross, E. (1969). On death and dying. New York, NY: Macmillan.

loved one's suffering has ended, compounded by guilt and grief related to unresolved issues or the circumstances of death. Grief work may be especially difficult if a patient's death was painful, prolonged, accompanied by unwanted interventions, or unattended. Families that had no preparation or support during the period of imminent death may have a more difficult time finding a place for the painful memories.

Although some family members may experience prolonged or complicated mourning, most grief reactions fall within a "normal" range. The feelings are often profound; however, bereaved people eventually reconcile the loss and find a way to reengage with their lives. Grief and mourning are affected by several factors, including individual characteristics, coping skills, and experiences with illness and death; the nature of the relationship to the deceased; factors surrounding the illness and the death; family dynamics; social support; and cultural expectations and norms. Uncomplicated grief and mourning are characterized by a range of emotions and behaviors from sadness and yearning to thoughts about or preoccupation with the deceased and for many, a temporary withdrawal from the activities of living in which they engaged before the death (Shear, 2012).

After-death rituals, including preparation of the body, funeral practices, and burial rituals, are socially and culturally significant ways in which family members begin to accept the reality and finality of death. Preplanning of funerals is becoming increasingly common, and hospice professionals in particular help the family make plans for death, often involving the patient, who may wish to play an active role. Preplanning of the funeral relieves the family of the burden of making decisions in the intensely emotional period after a death.

In general, the period of mourning is an adaptive response to loss during which mourners come to accept the loss as real and permanent, acknowledge and experience the painful emotions that accompany the loss, experience life without the deceased, overcome impediments to adjustment, and find a new way of living in a world without the loved one. Particularly immediately after the death, mourners begin to recognize the reality and permanence of the loss by talking about the deceased and telling and retelling the story of the illness and death.

In reality, the work of grief and mourning takes time, and avoiding grief work after the death often leads to long-term adjustment difficulties. According to Rando (2000), mourning for a loss involves the "undoing" of psychosocial ties that bind mourners to the deceased, personal adaptation to the loss, and learning to live in the world without the deceased. Six key processes of mourning allow people to accommodate to the loss in a healthy way (Rando, 2000):

1. Recognition of the loss
2. Reaction to the separation and experiencing and expressing the pain of the loss
3. Recollection and reexperiencing the deceased, the relationship, and the associated feelings
4. Relinquishing old attachments to the deceased
5. Readjustment to adapt to the new world without forgetting the old
6. Reinvestment

Although many people complete the work of mourning with the informal support of families and friends, many find that talking with others who have had a similar experience, such as in formal support groups, normalizes the feelings and experiences and provides a framework for learning new skills to cope with the loss and create a new life. Hospitals, hospices, religious organizations, and other community organizations often sponsor bereavement support groups. Groups for parents who have lost a child, children who have lost a parent, widows, widowers, and gay men and lesbians who have lost a life partner are some examples of specialized support groups

Chart 59-10 ASSESSMENT

Assessing for Anticipatory Mourning in the Family Facing Life-Threatening Illness

Family Constellation

- Identify the members who constitute the patient's family. Who is important to the patient?
- Identify roles and relationships among the family members:
- Who is the primary caregiver?
- By what authority is this person the primary caregiver?

Cohesion and Boundaries

- How autonomous/interdependent are family members?
  - Degree of involvement with each other as individuals and as a family
  - Degree of bonding between family members
  - Degree of "teamwork" in the family
  - Degree of reliance on individual family members for specific tasks/roles
- How do family members differ in:
  - Personality?
  - Worldview?
  - Priorities?
- What are the implicit and explicit expectations or "rules" for behavior within the family?

Flexibility and Adaptability

- What is the family's ability to integrate new information?
- How does the family manage change?
- How able are the family members to assume new roles and responsibilities?

Communication

- What is the style of communication in the family, in terms of:
  - Openness?
  - Directness?
  - Clarity?
- What are the constraints on communication?
- What topics are avoided?

available in many communities. Nursing interventions for those experiencing grief and mourning are identified in Chart 59-11.

Complicated Grief and Mourning

Complicated grief and mourning are characterized by prolonged feelings of sadness and feelings of general worthlessness or hopelessness that persist long after the death, prolonged symptoms that interfere with activities of daily living (anorexia, insomnia, fatigue, panic), or self-destructive behaviors such as alcohol or substance abuse and suicidal ideation or attempts (Howarth, 2011). Complicated grief and mourning require professional assessment and can be treated with psychological interventions and, in some cases, with medications.

Coping with Death and Dying: Professional Caregiver Issues

Whether practicing in a trauma center, ICU, or other acute care setting, home care, hospice, long-term care, or the many locations where patients and their families receive ambulatory services, nurses are closely involved with complex and emotionally laden issues surrounding loss of life. To be most effective and satisfied with the care they provide, nurses should

Chart 59-11

Nursing Interventions for Grief and Mourning

Support the Expression of Feelings

- Encourage the telling of the story using open-ended statements or questions (e.g., "Tell me about your husband").
- Assist the mourner to find an outlet for their feelings: talking, attending a support group, keeping a journal, finding a safe outlet for angry feelings (writing letters that will not be mailed, physical activity).
- Assess emotional affect and reinforce the normalcy of feelings.
- Assess for guilt and regrets:
  - "Are you especially troubled by a certain memory or thought?"
  - "How do you manage those memories?"

Assess for the Presence of Social Support

- "Do you have someone to whom you can talk about your husband?"
- "May I help you find someone you can talk to?"

Assess Coping Skills

- "How are you managing day to day?"
- "Have you experienced other losses? How did you manage those?"
- "Are there things that you are having trouble doing?"
- "Do you have/need help with specific tasks?"

Assess for Signs of Complicated Grief and Mourning and Offer Professional Referral

- Are you preoccupied with thoughts of the deceased that interfere with your ability to care for yourself?
- Do you have frequent and prolonged intense emotional pain?

attend to their own emotional responses to the losses witnessed every day. Well before exhibiting symptoms of stress or burnout, nurses should acknowledge the difficulty of coping with others' pain on a daily basis and establish healthy practices that guard against emotional exhaustion. In hospice settings, where death, grief, and loss are expected outcomes of patient care, interdisciplinary colleagues rely on one another for support, using meeting time to express frustration, sadness, anger, and other emotions; to learn coping skills from one another; and to speak about how they were affected by the lives of those patients who have died since the last meeting. In many settings, staff members organize or attend memorial services to support families and other caregivers, who find comfort in joining one another to remember and celebrate the lives of patients. Finally, healthy personal habits, including diet, exercise, stress reduction activities (e.g., dance, yoga, T'ai chi, meditation), and sleep, help guard against the detrimental effects of stress.

CRITICAL THINKING EXERCISES

1. Your patient is a 46-year-old man who is hospitalized for complications associated with advanced colon cancer. He has metastases to the liver and the bone, exhibits anorexia and cachexia, and reports that his pain is controlled but he feels that he cannot catch his breath. He has three young children with his same sex partner of 15 years. He will be discharged home on hospice care. You note that his breathing does not appear labored, nor is he tachypneic. Does he have dyspnea? What would your comprehensive dyspnea assessment include?

2. Your patient is a 65-year-old woman with Class IV heart failure. She lives with her husband and two adult daughters in a mobile home park near the outpatient practice where you are seeing her today. She tells you that she feels so tired that she does not even want to get out of bed or eat most days, and that she thinks she is losing weight. What is the evidence base about anorexia and cachexia care? How will you evaluate the evidence?
3. You are a new hospice nurse in your third week of night shift in a freestanding hospice inpatient unit. Your patient, a 55-year-old woman with advanced ovarian cancer was admitted 3 days prior. When you enter her room at the beginning of your shift, you note that she is not arousable and is having periods of apnea. It is 11 pm and the nurse who reported off told you that the patient's family left at approximately 9 pm. You are not sure but you think that your patient might be imminently dying. You have four other patients you have not seen yet. What should you do first? Why? What additional actions should be taken?

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

American Nurses Association. (2015). Nursing scope and standards of practice (3rd ed.). Silver Spring, MD: Author.

Bondly, C., & Jatoi, A. (2015). Overview of the management of the anorexia/weight loss syndrome. In E. Bruera, I. Higginson, D. F. von Gunten, & T. Morita (Eds.). Textbook of palliative medicine and supportive care (2nd ed.). Boston, MA: CRC.

Center to Advance Palliative Care. (2015a). America's care of serious illness: 2015 state by state report card on access to palliative care in our nation's hospitals. New York, NY: Author.

Del Fabbro, E. (2015). Current and future care of patients with the anorexia-cachexia syndrome. 2015 ASCO Educational Book. Alexandria, VA: American Society of Clinical Oncology.

**Glaser, B. G., & Strauss, A. (1965). Awareness of dying. Chicago, IL: Aldine.

Hospice of Philadelphia. (2015). Signs of approaching death. Philadelphia, PA: Author.

**Jacox, A., Carr, D. B., & Payne, R. (1994). Management of cancer pain. Rockville, MD: Agency for Health Care Policy and Research.

**Kübler-Ross, E. (1969). On death and dying. New York, NY: Macmillan.

**Rando, T. A. (2000). Promoting healthy anticipatory mourning in intimates of the life-threatened or dying person. In T. A. Rando (Ed.): Clinical dimensions of anticipatory mourning. Champaign, IL: Research Press.

Wittenberg-Lyles, E., Goldmith, G., Ferrell, B. R., et al. (2013). Communication in palliative nursing. New York, NY: Oxford.

Journals and Electronic Documents

Alsolamy S. (2014). Islamic views on artificial nutrition and hydration in terminally ill patients. Bioethics, 28, 96–99.

American Academy of Hospice and Palliative Medicine. (2007). Position statements: Physician-assisted death. Retrieved on 10/5/2015 at: www.aahpm.org/positions/default/suicide.html

**American Nurses Association. (2010). Position statement: Registered nurses' roles and responsibilities in providing expert care and counseling at the end of life. Retrieved on 10/5/2015 at: gm6.nursingworld.org/MainMenuCategories/EthicsStandards/Ethics-Position-Statements/etpain14426.pdf

American Nurses Association. (2013). Position statement: Euthanasia, assisted suicide, and aid in dying. Retrieved on 12/12/2015 at: www.nursingworld.org/MainMenuCategories/EthicsStandards/Ethics-Position-Statements/Euthanasia-Assisted-Suicide-and-Aid-in-Dying.pdf

Arensmeyer, K. (2012). Nursing management of patients with cancer-related anorexia. Retrieved on 11/12/2015 at: www.oncolink.org/resources/article.cfm?id=1006

*Benkel, I., Wijk, H., & Molander, U. (2010). Using coping strategies is not denial: Helping loved ones to adjust to living with a patent with a palliative diagnosis. Journal of Hospice and Palliative Medicine, 13(9), 1119–1123.

Beng, T. S., Ahmad, F., Loong, L. C., et al. (2015). Distress reduction for palliative care patients and families with 5-minute mindful breathing: A pilot study. American Journal of Hospice and Palliative Medicine. Epub ahead of print, pii: 1049909115569048

Bernacki, R. E., & Block, S. D. (2014). Communication about serious illness goals: A review and synthesis of best practices. JAMA Internal Medicine, 174(12), 1994–2003.

Bernat, J. L. (2009). Contemporary controversies in the definition of death. Progress in Brain Research, 177, 21–23.

**Casarett, D. J., Kapo, J., & Kaplan, A. (2005). Appropriate use of artificial nutrition and hydration—fundamental principles and recommendations. New England Journal of Medicine, 353(24), 2607–2612.

Center to Advance Palliative Care. (2015b). Member resources. Retrieved on 11/12/2015 at: www.capc.org/providers/member-resources/

"Common Cause (A Regd. Society) v. Union of India – (2014) 5 SCC 338 [Euthanasia reference to Constitution Bench]". 1, Law Street. Supreme Court of India. 24 February 2014. Retrieved on 05/18/2018.

Connor, S. R. (2007–2008). Development of hospice and palliative care in the United States. Omega, 56(1), 89–99.

Cronin, C., Arnstein, P., & Flanagan, J. (2015). Family members' perceptions of most helpful interventions during end-of-life care. Journal of Hospice & Palliative Nursing, 17(3), 223–228.

Danis, R., Arnold, R. M., & Savarese, D. M. F. (2015). *Stopping artificial nutrition and hydration at the end of life.* Retrieved on 11/21/2015 at: www.uptodate.com/contents/stopping-artificial-nutrition-and-hydration-at-the-end-of-life

Dewar, R., Cahners, N., Mitchell, C., et al. (2015). Hinduism and death with dignity: Historic and contemporary case examples. Journal of Clinical Ethics, 26(1), 40–47.

Enclara Pharmacia, Inc. (2015). Enclara Pharmacia Medication Use Guidelines (1st ed.). Philadelphia, PA: Author.

Fearon, K., Strasser, F., Anker, S. D., et al. (2011). Definition and classification of cancer cachexia: An international consensus. Lancet Oncology, 12, 489–495.

Gallup Poll. (2015). In U.S., support up for doctor-assisted suicide. Retrieved on 11/21/2015 at: www.gallup.com/poll/183425/support-doctor-assisted-suicide.aspx

Gibbs, K. D., Mahon, M. M., Truss, M., et al. (2015). An assessment of hospital-based palliative care in Maryland: Infrastructure, barriers, and opportunities. Journal of Pain and Symptom Management, 49(6), 1102–1108.

Government of West Bengal & National Rural Health Mission. (2016). Training module on palliative care (for doctors and nurses). Retrieved on 24/7/2022 at: https://www.wbhealth.gov.in/NCD/uploaded_files/all_files/Complete_module_of_NPPC_training.pdf.

Hoff, L., & Hermeren, G. (2014). Identifying challenges to communicating with patients about their imminent death. The Journal of Clinical Ethics, 25(4), 296–306.

Hospice and Palliative Nurses Association. (2011). HPNA position statement: Legalization of assisted suicide. Retrieved on 11/21/2015 at: www.hpna.org/DisplayPage.aspx?Title=Position%20Statements

Howarth, R. A. (2011). Concepts and controversies in grief and loss. Journal of Mental Health Counseling, 33(1), 4–10.

"India's top court upholds passive euthanasia, allows living wills". Reuters. 2018. Retrieved 03/12/2018.

Institute of Medicine. (2014a). Dying in America: Improving quality and honoring individual preferences near the end of life. Retrieved

on11/21/2015 at: iom.nationalacademies.org/Reports/2014/Dying-In-America-Improving-Quality-and-Honoring-Individual-Preferences-Near-the-End-of-Life.aspx
Institute of Medicine. (2014b). Dying in America: IOM Committee's proposed core components of quality end-of-life care. Retrieved on 11/21/2015 at: iom.nationalacademies.org/~/media/Files/Report%20Files/2014/EOL/Table%20-%20Core%20Components%20of%20Quality%20Care.pdf
Kamal, A. H., Maguire, J. M., Wheeler, J. L., et al. (2012). Dyspnea review for the palliative care professional: Treatment goals and therapeutic options. Journal of Palliative Medicine, 15(1), 106–114.
Khanna, I., & Lal, A. (2016). Palliative care—an Indian perspective. ARC Journal of Public Health and Community Medicine, 1(4), 27–34.
Knabe, H. E. (2013). The meaning of hope for patients coping with a terminal illness: A review of the literature. *Journal of Palliative Care in Medicine*. Retrieved on 12/12/2015 at: www.omicsgroup.org/journals/the-meaning-of-hope-for-patients-coping-with-a-terminal-illness-a%20review-of-literature-2165–7386.S2-004.pdf
Lawlor, P. G., & Bush, S. H. (2014). Delirium diagnosis, screening and management. Current Opinion in Supportive and Palliative Care, 8(3), 286–295.
Linzer RD. (2013). Treatment of terminally ill patients according to Jewish law. The Virtual Mentor, 15, 1081–1087.
Marks, S., & Heinrich, T. (2013). Assessing and treating depression in palliative care patients. Current Psychiatry, 12(8), 35–40.
McCormick, A. J. (2013). Buddhist ethics and end-of-life **c**are decisions. Journal of Social Work in End- Of-Life & Palliative Care, 9, 209–225.
McGuire, D. B., Reifsnyder, J., Soeken, K., et al. (2011). Assessing pain in non-responsive hospice patients: Development and preliminary testing of the Multidimensional Objective Pain Assessment Tool. Journal of Palliative Medicine, 14(3), 287–292.
Ministry of Health and Family Welfare, Government of India. (2021). Training manual on palliative care for staff nurses at Ayushman Bharat—health and wellness. Retrieved on 24/7/2022 at: https://nhsrcindia.org/sites/default/files/2021-12/Palliative%20Care%20Training%20Manual%20for%20Staff%20Nurse%20at%20AB-HWC.pdf.
Mitchell, S. L., Black, B. S., Ersek, M., et al. (2012). Advanced dementia: State of the art and priorities for the next decade. Annals of Internal Medicine, 156(1), 45–51.
Mitera, G., Zhang, L., Sahgal, A., et al. (2012). A survey of expectations and understanding of palliative radiotherapy from patients with advanced cancer. Clinical Oncology, 24(2), 134–138.
National Consensus Project for Quality Palliative Care. (2013). Clinical practice guidelines for quality palliative care (3rd ed.). Retrieved on 10/14/2015 at: www.nationalconsensusproject.org
National Hospice and Palliative Care Organization. (2010). Preamble and philosophy. Retrieved on 10/14/2015 at: www.nhpco.org/i4a/pages/index.cfm?pageid=5308
Oncology Nursing Society. (2014). Role of the nurse when hastened death is requested (endorsed position statement Hospice and Palliative Nurses Association). Retrieved on 11/18/2015 at: www.ons.org/advocacy-policy/positions/ethics/hastened-death
Oregon Public Health Division. (2015). Oregon's Death with Dignity Act—2014. Retrieved on 11/18/2015 at: public.health.oregon.gov/ProviderPartnerResources/EvaluationResearch/DeathwithDignit yAct/Documents/year17.pdf
Pew Research Center. (2013). Views on end-of-life medical treatments. Retrieved on 12/11/2015 at: www.pewforum.org/files/2013/11/end-of-life-survey-report-full-pdf.pdf
**Puchalski, C., & Romer, A. L. (2000). Taking a spiritual history allows clinicians to understand patients more fully. Journal of Palliative Medicine, 3(1), 129–137.
Puchalski, C. M., Vitillo, R., Hull, S. K., et al. (2014). Improving the spiritual dimension of whole person care: Reaching national and international consensus. Journal of Palliative Medicine, 17(6), 642–656.
Rabow, M., Kvale, E., Barbour, L., et al. (2013). Moving upstream: A review of the evidence of the impact of outpatient palliative care. Journal of Palliative Medicine, 16(12), 1540–1549.
Reynolds, R., Drew, D., & Dunwoody, C. (2013). American Society for Pain Management Nursing position statement: Pain management at the end of life. Pain Management Nursing, 14(3), 172–175.
Robson, A., Scrutton, F., Wilkinson, L., et al. (2010). The risk of suicide in cancer patients: A review of the literature. Psychooncology, 19(12),1250–1258.
Sarafis, P., Tsounis, A., Malliarou, M., et al. (2014). Disclosing the truth: A dilemma between instilling hope and respecting patient autonomy in everyday clinical practice. Global Journal of Health Science, 6(2), 128–137.
Schildmann, E. K., Schildmann, J., & Kiesewetter, I. (2015). Medication and monitoring in palliative sedation therapy: A systematic review and quality assessment of published guidelines. Journal of Pain and Symptom Management, 49(4), 734–746.
Shear, M. K. (2012). Grief and mourning gone awry: Pathway and course of complicated grief. Dialogues in Clinical Neuroscience, 14(2), 119–128.
**SUPPORT Principal Investigators. (1995). A controlled trial to improve care for seriously ill hospitalized patients. JAMA, 274(20), 1591–1598.
**Temel, J. S., Greer, J. A., Muzikansky, A., et al. (2010). Early palliative care for patients with metastatic non-small-cell lung cancer. New England Journal of Medicine, 363(8), 733–742.
The Conversation Project. (2013). New survey reveals "conversation disconnect." Retrieved on 12/11/2015 at: theconversationproject.org/wp-content/uploads/2013/09/TCP-Survey-Release_FINAL-9-18-13.pdf
The Joint Commission. (2011). Facts about the advanced certification program for palliative care. Retrieved on 10/5/2015 at: www.jointcommission.org/assets/1/18/Palliative_Care.pdf
Vermont Department of Health. (2015). Patient choice and control at end of life. Retrieved on 11/18/2015 at: healthvermont.gov/family/end_of_life_care/patient_choice.aspx
Washington State Department of Health. (2015). Death with Dignity Act. Retrieved on 11/18/2015 at: www.doh.wa.gov/YouandYourFamily/IllnessandDisease/DeathwithDignityAct
**Wittenberg-Lyles, E., Goldsmith, J., & Ragan, S. L. (2010). The COMFORT initiative: Palliative nursing and the centrality of communication. Journal of Hospice and Palliative Nursing, 12(5), 282–292.
World Health Organization (WHO). (2020). Global atlas of palliative care (2nd ed.). Retrieved on 24/7/2022 at: https://www.thewhpca.org/resources/global-atlas-on-end-of-life-care.
World Palliative Care Alliance. (2014). Global atlas of palliative care at the end of life. Retrieved on 12/11/2015 at: www.who.int/nmh/Global_Atlas_of_Palliative_Care.pdf
Wright, D. K., Brajtman, S., & Macdonald, M. E. (2014). A relational ethical approach to end-of-life delirium. Journal of Pain and Symptom Management, 48(2), 191–198.
Zientek, D. M. (2013). Artificial nutrition and hydration in Catholic healthcare: Balancing tradition, recent teaching, and law. HEC Forum, 25, 145–159.

Resources

American Academy of Hospice and Palliative Medicine (AAHPM), www.aahpm.org/
American Hospice Foundation, www.americanhospice.org/
Americans for Better Care of the Dying (ABCD), www.abcd-caring.org/
Association for Death Education and Counseling (ADEC), www.adec.org/
Caring Connections: a program of the National Hospice and Palliative Care Organization, www.caringinfo.org/i4a/pages/index.cfm?pageid=1
Center to Advance Palliative Care, www.capc.org/
Children's Hospice International, www.chionline.org/
Compassion & Choices, www.compassionandchoices.org/
Directory of State Hospice Organizations, www.hospicedirectory.org/cm/about/state_hospice
End-of-Life Nursing Education Consortium (ELNEC), www.aacn.nche.edu/elnec
Family Caregiver Alliance (FCA), caregiver.org/
Get Palliative Care (Blog and resources for palliative care), getpalliativecare.org/resources/
Growth House, Inc., provides information and referral services for agencies working with death and dying issues, www.growthhouse.org/

Harvard Medical School Center for Palliative Care, Dana Farber Cancer Institute, www.hms.harvard.edu/pallcare/

Hospice and Palliative Credentialing Corporation (HPCC), hpcc.advancingexpertcare.org/

Hospice and Palliative Nurses Association (HPNA), www.hpna.org

Hospice Association of America, National Association for Home Care, www.nahc.org/haa/

Hospice Education Institute, www.hospiceworld.org/

Hospice Foundation of America (HFA), www.hospicefoundation.org/

Hospice Net, provides information and support to patients and families facing life-threatening illnesses, www.hospicenet.org/

International Association for Hospice & Palliative Care (IAHPC), hospicecare.com/home/

National Consensus Project for Quality Palliative Care (national guidelines), www.nationalconsensusproject.org

National Palliative Care Research Center (NPCRC), Brookdale Department of Geriatrics and Adult Development, www.npcrc.org

National Prison Hospice Association, www.npha.org

Office of End of Life and Palliative Care Research (OEPCR), www.ninr.nih.gov/reasearchandfunding/dea/desp/oepcr#.VhO5YCjnOLO

Palliative Care Fast Facts and Concepts, www.capc.org/fast-facts/

POLST (Physician Orders for Life-Sustaining Treatment Paradigm), www.polst.org/

Promoting Excellence in End-of-Life Care, www.promotingexcellence.org/

Supportive Care Coalition, www.supportivecarecoalition.org/

TIME: Toolkit of Instruments to Measure End-of-Life Care (Brown University), www.chcr.brown.edu/pcoc/toolkit.htm

We Honor Veterans (Partnership Between Veterans Administration and NHPCO), www.wehonorveterans.org/

World health Organization (WHO) Palliative Care, www.who.int/cancer/palliative/en/

UNIT

XIX

Emergency and Disaster Nursing

Chapter 60 Emergency Nursing 1977

Chapter 61 Terrorism, Mass Casualty, and Disaster Nursing 2012

CHAPTER 60

Emergency Nursing

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Describe emergency care as a collaborative, holistic approach that includes the patient, the family, and significant others.
2. Discuss priority emergency measures instituted for the patient with an emergency condition.
3. Identify the priorities of care for the patient with multiple system injuries.
4. Compare and contrast the emergency management of patients with heat stroke, frostbite, and hypothermia.
5. Specify the similarities and differences of the emergency management of patients with swallowed or inhaled poisons, skin contamination, animals and snake bites, and food poisoning.
6. Explain the emergency management of patients with drug overdose, those with acute alcohol intoxication, and those who have been sexually assaulted.
7. Differentiate between the emergency care of patients who are overactive, those who are violent, those who are depressed, and those who are suicidal.
8. Identify the legal and ethical issues involved in emergency nursing.

GLOSSARY

antivenin: antitoxin manufactured from venom of poisonous snakes to assist the patient's immune system response to an envenomation
carboxyhemoglobin: hemoglobin that is bound to carbon monoxide and therefore is unable to bind with oxygen, resulting in hypoxemia
corrosive poison: alkaline or acidic agent; causes tissue destruction after contact
cricothyroidotomy: surgical opening of the cricothyroid membrane to obtain an airway that is maintained with a tracheostomy or endotracheal tube
envenomation: injection of a poisonous material by sting, spine, bite, or other means
fasciotomy: surgical incision of the extremity to the level of the fascia to relieve pressure and restore neurovascular function to the extremity
multiple trauma: trauma caused by a single catastrophic event that causes life-threatening injuries to at least two distinct organs or organ systems
primary survey: an assessment of the patient triaged to the emergent or resuscitation category that focuses on stabilizing life-threatening conditions; uses the mnemonic ABCDE, which stands for *a*irway, *b*reathing, *c*irculation, *d*isability, and *e*xposure
rhabdomyolysis: a toxic syndrome caused by widespread injury to skeletal muscle, resulting in myoglobinuria and acute kidney injury
secondary survey: an assessment of the patient triaged to the emergent or resuscitation category that commences after the primary survey is completed and life-threatening insults addressed; includes obtaining vital signs, completing a head-to-toe examination, and obtaining the patient's pertinent medical-surgical history, including the history of the current event
sentinel event: an unanticipated event that results in patient harm
triage: process of assessing patients to determine management priorities

Introduction

The term *emergency management* traditionally refers to care given to patients with urgent and critical needs. However, because many people lack access to health care, the emergency department (ED) is increasingly used for nonurgent problems. Therefore, the philosophy of emergency management has broadened to include the concept that an emergency is whatever the patient or the family considers it to be.

The emergency nurse has had specialized education, training, experience, and expertise in assessing and identifying patients' health care problems in crisis situations. In addition, the emergency nurse establishes priorities, monitors, and continuously assesses patients who are acutely ill and injured, supports and attends to families, supervises allied health personnel, and educates patients and families within a time-limited, high-pressured care environment. Nursing interventions are accomplished interdependently, in consultation with or under the direction of a physician. The roles of nursing and medicine are complementary in an emergency situation. Appropriate nursing and medical interventions are anticipated based on assessment data. Members of the emergency health care staff work as a team in performing the highly technical, hands-on skills required to care for patients in emergency situations (Emergency Nurses Association [ENA], 2013).

Large numbers of people seek emergency care for serious life-threatening conditions, such as cardiac dysrhythmias, acute coronary syndrome, acute heart failure, pulmonary edema, and stroke. Priorities for managing these cardiac and other conditions are discussed in Chapters 20, 21, 23, and 50. Emergency management of trauma and conditions not found elsewhere in this book are discussed in this chapter.

ISSUES IN EMERGENCY NURSING CARE

Emergency nursing is demanding because of the diversity of conditions and situations that present unique challenges. These challenges include legal issues, occupational health and safety risks for ED staff, and the challenge of providing holistic care in the context of a fast-paced, technology-driven environment

in which serious illness and death are encountered on a daily basis. Another dimension of emergency nursing is nursing in disasters. With the increasing use of weapons of terror and mass destruction, both internationally and at home, the emergency nurse must recognize and treat patients exposed to biologic and other weapons, anticipating nursing care in the event of a mass casualty incident from natural causes or a terrorist event (see Chapter 61).

Documentation of Consent and Privacy

Consent to examine and treat the patient is part of the ED record. The patient needs to give consent for invasive procedures (e.g., angiography, lumbar puncture) unless he or she is unconscious or in a critical condition and unable to make decisions. If the patient is unconscious and brought to the ED without family or friends, this fact must be documented. Monitoring of the patient's condition, as well as all instituted treatments and the times at which they were performed, must be documented. After treatment, a notation is made on the record about the patient's condition, response to the treatment, and condition at discharge or transfer and about instructions given to the patient and family for follow-up care.

According to the Indian law, the patients who arrive with fatal accidents or injury due to violence also deserve the best possible timely care and it is the obligatory act expected from the emergency health care team (Pinto, 2017), In every ED, the physician must perform a medical screening examination on all patients arriving with an emergency medical complaint if their acute signs and symptoms could result in serious injury or death if left untreated. EDs are also required to provide treatment aimed at stabilizing each patient's condition. If the patient must be transferred to another facility, the patient's consent for transfer should be obtained, if possible. In addition, acceptance by the receiving facility and physician must be obtained, and an appropriate method of transfer for the patient should be secured. Documentation of assessment and treatment must be sent with the patient upon transfer (ENA, 2013).

Limiting Exposure to Health Risks

Because of the increasing numbers of people infected with hepatitis, human immune deficiency virus (HIV), tuberculosis, and other infectious diseases, health care providers are at an increased risk for exposure to communicable diseases through blood, respiratory droplets, or other body fluids. This risk is further compounded in the ED because of the common use of invasive treatments in patients who may have a wide range of conditions and are unable to provide a comprehensive medical history. All emergency health care providers must adhere strictly to standard precautions for minimizing exposure.

The re-emergence of tuberculosis and certain airborne infections like SARS warrant the nurses in the ED to be wearing a high-efficiency particulate air (HEPA) filter masks while treating patients with airborne diseases.

Nursing Alert: To limit the risk of exposure to airborne diseases, early identification and strict adherence to transmission-based precautions for patients who are potentially infectious is crucial.

The potential for exposure to highly contagious organisms, hazardous chemicals or gases, and radiation related to acts of terrorism or natural or man-made disasters presents additional risks to ED staff. See Chapter 61 for information about decontamination procedures.

Violence in the Emergency Department

Not only do ED staff members encounter patients who may be violent because of the effects of substance abuse, injury, or other emergencies, they may also encounter other violent situations. Patients and families waiting for assistance may be emotionally volatile. Often, waiting rooms are the sites where feelings of dissatisfaction, fear, and anger are channeled violently. Some EDs assign security officers or off duty police to the area and have installed silent alarm systems or metal detectors to identify weapons in order to protect patients, families, and staff. Safety is the first priority.

Patients and family members under the influence of illicit drugs or alcohol, or who may have psychiatric disorders, including delirium or dementia, or who may be influenced by social situations such as gang membership, are at risk for committing a violent act, whether intentional or not (Avander, Heikki, Bjersa, et al., 2016). The environment of the ED, including being subjected to long wait times and crowded conditions, may also increase their risk of committing violent events. Physical threats are most often accompanied by verbal abuse, which is the most common type of violence (American College of Emergency Physicians [ACEP], 2011). Although not a typical occurrence, a patient or family member may come to the ED armed. To avoid angry confrontations, members of gangs and families who are feuding need to be separated in the ED, in the waiting room, and later in the inpatient nursing unit. Nurses and other personnel must be prepared to deal with these circumstances. The ED should be locked against entry if security is questionable.

Patients who are violent or potentially violent must be vigilantly monitored by the ED staff. Care must be taken to avoid injury. Patients from prison and those who are under guard need to be handcuffed to the bed and appropriately assessed to ensure the safety of hospital staff and other patients. The emergency nurse must understand how to employ safe use of restraints. The Joint Commission has strict standards regarding documentation of the reason, monitoring for safety, and ensuring the dignity of the patient who is restrained (Solheim, 2016). Precautions to be taken to avoid injury include the following situations (ENA 2013); (Speroni, Fitch, Dawson, et al., 2014):

- For prisoners, the hand or ankle restraint (handcuff) is never released, and a guard is always present in the room.
- A mask can be placed on the patient to prevent spitting or biting.
- Nonrestraint techniques should be tried when possible—e.g., talking with the patient, minimizing environmental stimulation.
- Physical restraints are used on any patient who is violent only as needed and, if used, should be humanely and professionally given (ACEP, 2014); nonetheless, the staff should be cognizant that the patient could head-butt, even if restrained.
- Distance should be maintained from the patient to avoid grabbing; staff should not wear items that can be grabbed by the patient, such as dangling jewelry and stethoscopes. Furthermore, distance should be maintained between the

patient and the door so that an escape route for the staff member is preserved.
- Objects should not be left within patient reach; even an intravenous (IV) line spike can become a tool of violence if the patient is determined.
- Courses on safety (de-escalation and physical restraint techniques) assist the staff with preparing for various violent situations.

In the case of gunfire in the ED, self-protection is a priority. There is no advantage to protecting others if health care providers are injured. Security officers and police must gain control of the situation first, and then care is provided to the injured.

Providing Holistic Care

Patients and families experiencing sudden injury or illness are often overwhelmed by anxiety because they have not had time to adapt to the crisis. They experience real and terrifying fear of death, mutilation, immobilization, and other assaults on their personal identity and body integrity. When confronted with trauma, severe disfigurement, severe illness, or sudden death, the family experiences several stages of crisis. The stages begin with anxiety and progress through denial, remorse and guilt, anger, grief, and reconciliation. The initial goal for the patient and family is anxiety reduction, a prerequisite to effective and appropriate coping. During this stressful time, safety is of prime importance. Close observation and preplanning are essential and security personnel are stationed nearby in the event that a patient or family member responds to stress with physical violence.

Assessment of the patient and family's psychological function includes evaluating emotional expression, degree of anxiety, and cognitive functioning. Possible nursing diagnoses include:
- Anxiety or death anxiety related to uncertain potential outcomes of the illness or trauma
- Ineffective coping related to acute situational crisis

Possible nursing diagnoses for the family include:
- Grieving
- Interrupted family processes
- Compromised or disabled family coping related to acute situational crises

Patient-Focused Interventions

Clinicians caring for the patient should act confidently and competently to relieve anxiety and promote a sense of security. Explanations should be given that the patient can understand. Human contact and reassuring words reduce the panic of the person who is severely injured or ill and aid in dispelling fear of the unknown.

The patient who is unconscious should be treated as if conscious—that is, the patient should be touched, called by name, and given an explanation of every procedure that is performed. As the patient regains consciousness, the nurse should orient the patient by stating their name, the date, and the location. This basic information should be provided repeatedly, as needed, in a reassuring way.

Ensuring patient safety is a major focus in clinical practice settings. Some of the most common sentinel events (unanticipated events that result in patient harm) in the ED include delays to care and medication errors. Common root causes for these sentinel events revolve around nurse staffing patterns, patient volume, and specialty availability. Solutions to patient safety issues in the ED include ensuring optimal nurse staffing, pharmacy presence, and rapid diagnostics turnaround times to minimize wait time to diagnosis and fostering teamwork and support by leadership. All errors should be reported and investigated even if a patient was not harmed. In this way, future injury or death may be avoided (ENA, 2013).

Family-Focused Interventions

The family is kept informed about where the patient is, how he or she is doing, and the care that is being given. Encouraging family members to stay with the patient, when possible, also helps allay their anxieties. In many facilities, family presence during resuscitation is permitted to assist the family to cope through this difficult time. Many family members respond very well to this approach. One study found that families view emergency professionals favorably when a family member was resuscitated. They view their role as supportive and protective of the patient. Allowing family presence in the critical care areas of the hospital enhances the family role and builds trust in the caregivers (Leske, McAndrew, & Brasel, 2013). Posttraumatic stress disorder (PTSD) is less likely to occur if the family member is present during resuscitation (Jabre, Belpomme, Azoulay, et al., 2013). The presence of a family facilitator, who is trained to provide support to family members, is vital to the success of a family presence program. Additional interventions are based on the assessment of the stage of crisis that the family is experiencing. Measures to help family members cope with sudden death are presented in Chart 60-1.

Chart 60-1

Helping Family Members Cope with Sudden Death

The nurse takes the following actions:
- Take the family to a private place.
- Talk to the family together so that they can grieve together and hear the information given together.
- Reassure the family that everything possible was done; inform them of the treatment rendered.
- Avoid using euphemisms such as "passed on." Show the family that you care by touching, offering coffee and water.
- Encourage family members to support each other and to express emotions freely (grief, loss, anger, helplessness, tears, disbelief).
- Avoid giving sedation to family members; this may mask or delay the grieving process, which is necessary to achieve emotional equilibrium and to prevent prolonged depression.
- Encourage the family to view the body if they wish; this action helps to integrate the loss. Cover disfigured and injured areas before the family sees the body. Go with the family and do not leave them alone. Show acceptance by touching the body to give the family "permission" to touch.
- Spend time with the family, listening to them and identifying any needs that they may have for which the nursing staff can be helpful.
- Allow family members to talk about the deceased and what he or she meant to them; this permits ventilation of feelings of loss. Encourage the family to talk about events preceding admission to the emergency department. Do not challenge initial feelings of anger or denial.
- Avoid volunteering unnecessary information (e.g., the patient was drinking).

Anxiety and Denial

During these crises, family members are encouraged to recognize and talk about their feelings of anxiety. Asking questions is encouraged. Honest answers given at the level of the family's understanding must be provided. Although denial is an ego-defense mechanism that protects one from recognizing painful and disturbing aspects of reality, prolonged denial is not encouraged or supported. The family must be prepared for the reality of what has happened and what may come.

Remorse and Guilt

Expressions of remorse and guilt are common, with family members accusing themselves (or each other) of negligence or minor omissions. Family members are urged to verbalize their feelings to help them cope appropriately.

Anger

Expressions of anger, common in crisis situations, are a way of handling anxiety and fear. Anger is frequently directed by the family at the patient, but it is also often expressed toward the physician, the nurse, or admitting personnel. The therapeutic approach is to allow the anger to be expressed and to assist the family members to identify their feelings of frustration.

Grief

Grief is a complex emotional response to anticipated or actual loss. The key nursing intervention is to help family members work through their grief and to support their coping mechanisms, letting them know that it is normal and acceptable for them to cry, feel pain, and express loss.

Caring for Emergency Personnel

Concerted efforts have been made to focus on the needs of the ED staff, especially after serious and stressful events (ENA, 2013). Events can range from a local trauma case involving children; to treating someone known to the emergency worker, such as a colleague or family member; to a more complex natural disaster or multicasualty situation. It is important to remember that all staff members may not necessarily respond in the same way; an event that is stressful to one person may not be as stressful to another. Compassion fatigue may result from the continuous exposure to suffering and injury, and energy is expended on a daily basis. Fatigue occurs when the affected staff members cannot replenish the energy stores (Solheim, 2016). In addition, because stress is a daily occurrence in the ED, the staff may not recognize the personal effect of any one event or the cumulative effect of day-to-day crisis interventions. ED leadership should be aware of staff coping patterns and support systems, patterns of interactions between staff members, staff members' health problems, including addiction, and appropriately assist with identifying behaviors caused by workplace stress. The availability of nonjudgmental counseling is essential to promoting a healthy staff.

After serious events, critical incident stress management (CISM) is necessary to critique individual and group performance and to facilitate healthy coping. Optimally, this may consist of three steps: defusing, debriefing, and follow-up. Defusing occurs immediately after the critical incident. During this session, affected staff are encouraged to discuss their feelings about the incident and are given contact information so that they may talk to someone if they have disturbing symptoms (e.g., sleeplessness, excessive worry). Debriefing typically occurs 1 to 10 days after the critical incident. Debriefing sessions follow a format similar to the initial defusing session; however, during these sessions, participating staff are encouraged to discuss their feelings about the incident and are reassured that their negative reactions and feelings are normal and that their negative feelings will diminish over time. At the end of these sessions, participants should have a feeling of closure and be able to resume their professional roles at an emotional level commensurate to that prior to the critical incident. Some staff may require further professional follow-up, however. Follow-up may occur after the debriefing session is completed for those participants who have persistent negative symptoms and may consist of continued individual or group counseling and therapy (Solheim, 2016).

EMERGENCY NURSING AND THE CONTINUUM OF CARE

A key principle underlying emergency care is that the patient is rapidly assessed, treated, and referred to the appropriate setting for ongoing care. This makes the ED a temporary point on the continuum of care. Only 11.9% of patients who receive emergency care are admitted to the hospital, which means emergency nurses must plan and facilitate the patient's safe discharge and follow-up care in the home, community, and the transitional care environment (Cadogan, Phillips, & Ziminski, 2016).

Discharge Planning

Before discharge, verbal and written instructions for continuing care are given to the patient and the family or significant others. Many EDs have preprinted standard instruction sheets for the more common conditions (i.e., concussion), which can then be individualized. Discharge instructions should be available in a variety of languages. A language interpreter should be used as necessary to provide both written and verbal instructions.

Instructions should include information about prescribed medications, treatments, diet, activity, and when to contact a health care provider or schedule follow-up appointments. Discharge planning is the "teachable moment" for the patient, providing the opportunity to present injury prevention or smoking cessation strategies, alcohol counseling opportunities, and more. It is imperative that instructions are written legibly, use simple language, and are clear in their important points. When providing discharge instructions, the nurse also considers any special needs the patient may have related to hearing or visual impairments. Alternate formats of instruction (e.g., large print, Braille, audiotape) should be available to meet the needs of patients with hearing or visual impairments.

Community and Transitional Services

Before discharge, some patients require the services of a social worker to help them meet continuing health care needs. Home care resources may be contacted before discharge to arrange services. This is particularly important for patients who are older adults or who have disabilities and who need assistance. Identifying continuing health care needs and making arrangements for meeting these needs can prevent return visits to the ED or readmission to the hospital.

For patients who are returning to long-term care facilities and for those who already rely on community agencies for continuing health care, communication about the patient's condition and any changes in health care needs that have occurred must be provided to the appropriate facilities or agencies. This communication is essential to promote continuity of care and to ensure ongoing care that meets the patient's changing health care needs.

Many patients who utilize EDs have health problems that are nonurgent. Moreover, some patients return repeatedly to the ED with nonurgent problems (ENA, 2015a). It is posited that patients who present to the ED with nonurgent problems do so because there is a dearth of outpatient health care resources to fill their needs.

Gerontologic Considerations

The ED is a common point of entry into the health care system for patients 65 years and older. The Centers for Disease Control and Prevention (CDC, 2013) reports that 36.5% of ED visits by patients older than 65 years resulted in hospital admission. As age increases, the percentage of admissions increases. Of these admissions, 29% were related to trauma, primarily falls (CDC, 2013). Older adult patients typically arrive with one or more presenting conditions. Nonspecific symptoms, such as weakness and fatigue, episodes of falling, incontinence, and change in mental status, may be manifestations of acute, potentially life-threatening illness in the older person. Emergencies in this age group may be more difficult to manage because older adult patients may have an atypical presentation, an altered response to treatment, a greater risk of developing complications, or a combination of these factors.

The older adult patient may perceive the emergency as a crisis signaling the end of an independent lifestyle or even resulting in death. The nurse should give attention to the patient's feelings of anxiety and fear.

The older patient may have limited sources of social and financial support during these times of crises. The nurse should assess the psychosocial resources of the patient (and of the caregiver, if necessary) and anticipate discharge needs

Obesity Considerations

The considerations in ED management of patients with obesity include an understanding that it is generally more challenging to insert IV lines and airways. Ventilation also can be a challenge from the increased weight of the chest wall and the increased incidence of hypoventilation and sleep apnea among patients with obesity. Special consideration must be taken with lipophilic medications, as they take longer to clear from the larger volume of adipose tissue. Weight-based medications must be calculated carefully using ideal body mass. X-rays may be difficult to visualize because of poor penetration.

Complications that patients with obesity are more prone to experience during hospitalization include respiratory failure, acute kidney injury, pneumonia, deep vein thrombosis, and pressure ulcers. Patients with severe obesity who have femur fractures have a significantly higher risk of death, as well as a higher risk of acute respiratory distress syndrome (ARDS) and sepsis than patients of normal weight (Weinlein, Deadrick, & Murphy, 2015). Although many of these complications do not occur until later in the hospital stay, some preventive measures (e.g., encouraging turning, coughing, and deep-breathing exercises to prevent atelectasis) may be initiated in the ED. Functional recovery time is extended in patients with obesity, resulting in longer lengths of stay and increased hospital costs. Initiating prevention measures in the ED, such as early backboard removal and providing early preventive respiratory care, are targeted to improve recovery time (Childs, Nahm, Dolenc, et al., 2015); (Dhungel, Liao, Raut, et al., 2015). Arranging transfers of patients with obesity must also take into consideration the availability of appropriately sized equipment.

PRINCIPLES OF EMERGENCY CARE

By definition, emergency care is care that must be rendered without delay. In an ED, several patients with diverse health problems—some life threatening, some not—may present to the ED simultaneously. One of the first principles of emergency care is triage.

Triage

The word triage comes from the French word *trier,* meaning "to sort." In the daily routine of the ED, triage is used to sort patients into groups based on the severity of their health problems and the immediacy with which these problems must be treated.

A basic and widely used triage system that had been in use for many years utilized three categories: emergent, urgent, and nonurgent. In this system, emergent patients had the highest priority, urgent patients had serious health problems but not immediately life-threatening ones, and nonurgent patients had episodic illnesses. Most of the Indian hospitals follow the three-category triaging system which is advocated by the National Disaster Management Authority of India.

Category I/Emergent category (Life-threatening illness): The patient needs medical care with zero delay. Acute severe chest pain, continuous seizures, massive bleeding, major trauma with hypotension, head injury with unconsciousness are some exemplars that fall in this category. These patients need continuous monitoring by the nurse and may be shifted to resuscitation bay and then to the ICU or operation theater (OR).

Category II/Urgent category (Potential for life-threatening illness): The possibility of impending or emerging life-threatening illness is expected but not with any life-threatening illness. Patients in this category may require careful medical evaluation and treatment initiated within 10 minutes. Dyspnea, high-grade fever, acute confusion, acute abdomen, serious injury to extremity can be placed in Category II.

Category III/(Non–life-threatening conditions): There is no obvious or impending life-threatening illness. These patients can be examined and treated in the order of their arrival to the ED in a non-hurried manner. Chronic pain, fever, simple fracture to limbs or dislocation of joints, minor injuries that need wound cleansing and dressing are few examples for this category (National Disaster Management Guidelines Hospital Safety, 2016).

A comprehensive, valid, and reliable five-level triage severity rating system that recognizes that EDs are used for both emergency and routine health care is also used. The increased number of triage levels assists the triage nurse to more precisely determine the needs of the patient and the urgency for treatment. Systems that meet these criteria for validity and

reliability that are commonly used in the United States are the Emergency Severity Index (ESI) and the Canadian Triage and Acuity Scale (CTAS). The ESI assigns patients into five levels, from level 1 (most urgent) to level 5 (least urgent). With the ESI, patients are assigned to triage levels based on both their acuity and their anticipated resource needs (Gilboy, Tanabe, Travers, et al., 2012). The CTAS system's five levels include time parameters that guide how frequently patients must be reassessed by either a nurse or provider. Patients assigned to the *resuscitation* category must receive continuous nursing surveillance, those in the *emergent* category must be reassessed at least every 15 minutes, patients in the *urgent* category must be reassessed at least every 30 minutes, patients in the *less urgent* category must be reassessed at least every 60 minutes, and those in the *nonurgent* category must be reassessed at least every 120 minutes. The goal of all triage is rapid assessment and decision-making, preferably under 5 minutes (ENA 2013).

Triage is an advanced skill. Emergency nurses spend many hours learning to classify different illnesses and injuries to ensure that patients most in need of care do not needlessly wait. Protocols may be followed to initiate laboratory or x-ray studies while the patient is in the triage area. Collaborative protocols are developed and used by the triage nurse based on their level of experience. Nurses in the triage area collect additional crucial baseline data: full vital signs including pain assessment, history of the current event and past medical history, neurologic assessment findings, weight, allergies (especially to latex and medications), domestic violence screening, and necessary diagnostic data. Some facilities collect these data in a computerized system, which help guide the nurse through assessment and documentation. Asking questions is key to appropriate triage decisions. The following questions reflect the minimum information that should be obtained from the patient or from the person who accompanied the patient to the ED (so long as that person is not suspected of abuse or neglect; see later discussion) and then are documented:

- What were the circumstances, precipitating events, location, and time of the injury or illness?
- When did the symptoms appear?
- Was the patient unconscious after the injury or onset of illness?
- How did the patient get to the ED?
- What was the health status of the patient before the injury or illness?
- Is there a history of medical illness or previous surgeries? A history of admissions to the hospital?
- Is the patient currently taking any medications, especially hormones, insulin, digitalis, or anticoagulants? Is the patient using any complementary or alternative therapies such as herbology, naturopathy, Reiki, massage, or acupuncture?
- Does the patient have any allergies, especially to latex, medications, eggs, or nuts?
- Does the patient use tobacco products or recreational drugs? How frequently? What type? When was the last time they were used?
- Does the patient have any fears? Does the patient feel that he or she is in danger or in an unsafe situation?
- When was the last meal eaten? (This is important if general anesthesia is to be given or if the patient is unconscious.)
- When was the last menstrual period?
- Is the patient under a physician's care? What are the name and contact information for the physician?
- What was the date of the patient's most recent tetanus immunization?

In addition to the collection of initial vital signs and medical history, triage consists of providing basic first aid, which may include application of ice, bleeding control, and basic wound care, as well as initiating protocol-based prescriptions (e.g., x-rays, administering antipyretic or mild analgesic agents, obtaining an electrocardiogram [ECG] or urinalysis, removing sutures). The triage nurse also is responsible for and monitors the waiting area, maintains a safe environment, reassesses patients who are waiting, and is the initial liaison to the families of patients.

Routine ED triage protocols differ significantly from the triage protocols used in disasters and mass casualty incidents (field triage). Routine triage directs all available resources to the patients who are most critically ill, regardless of potential outcome. In field triage (or hospital triage during a disaster), scarce resources must be used to benefit the most people possible. This distinction affects triage decisions (see Chapter 61).

Assess and Intervene

For the patient assigned to an urgent or higher triage category, stabilization, provision of critical treatments, and prompt transfer to the appropriate setting (intensive care unit, operating room, general care unit) are the priorities of emergency care. Although treatment is initiated in the ED, ongoing definitive treatment of the underlying problem is provided in other settings, and the sooner the patient is stabilized and moved to that area, the better the outcome.

A systematic approach to effectively establishing and treating health priorities is the primary survey/secondary survey approach. The primary survey focuses on stabilizing life-threatening conditions. The ED staff work collaboratively and follow the ABCDE (*a*irway, *b*reathing, *c*irculation, *d*isability, *e*xposure) method:

- Establish a patent airway.
- Provide adequate ventilation, employing resuscitation measures when necessary. Patients who have experienced trauma must have the cervical spine protected and chest injuries assessed first, immediately after the airway is established.
- Evaluate and restore cardiac output by controlling hemorrhage, preventing and treating shock, and maintaining or restoring effective circulation. This includes the prevention and management of hypothermia. In addition, peripheral pulses are examined, and any immediate closed reductions of fractures or dislocations are performed if an extremity is pulseless.
- Determine neurologic disability by assessing neurologic function using the Glasgow Coma Scale (GCS) (See Chapter 51, Chart 51-2) and a motor and sensory evaluation of the spine (see Chapter 48, Fig. 48-9). A quick neurologic assessment may be performed using the AVPU mnemonic:
  - *A*—alert. Is the patient alert and responsive?
  - *V*—verbal. Does the patient respond to verbal stimuli?
  - *P*—pain. Does the patient respond only to painful stimuli?
  - *U*—unresponsive. Is the patient unresponsive to all stimuli, including pain?
- Undress the patient quickly but gently so that any wounds or areas of injury are identified; this may entail cutting away articles of clothing (American College of Surgeons [ACS], 2013).

After these priorities have been addressed, the ED team proceeds with the secondary survey. This includes the following:

- Complete health history, including the history of the current event
- Head-to-toe assessment (includes a reassessment of airway and breathing parameters and vital signs)
- Diagnostic and laboratory testing
- Insertion or application of monitoring devices such as ECG electrodes, arterial lines, or urinary catheters
- Splinting of suspected fractures
- Cleansing, closure, and dressing of wounds
- Performance of other necessary interventions based on the patient's condition

Once the patient has been assessed, stabilized, and tested, appropriate medical and nursing diagnoses are formulated, initial important treatment is started, and plans for the proper disposition of the patient are made. Many emergent and urgent conditions and priority emergency interventions are discussed in detail in the remaining sections of this chapter.

In addition to the management of the illness or injury, the ED nurse must also focus on providing comfort and emotional support to the patient and family. Included in this is pain management. Effective pain management must be instituted early and should include rapid-acting agents that result in minimal sedation so that the patient can continue to interact with the staff for ongoing assessment. Moderate sedation can help facilitate short procedures in the ED; the patient will not remember the procedure later. The patient is closely monitored during the procedure and then rapidly awakens when it is complete

It is essential that family crisis intervention services are available for families of patients in the ED. Even if a patient's condition is not emergent, the situation may be perceived as such by the family. Every family needs attention and support.

AIRWAY OBSTRUCTION

Acute upper airway obstruction is a life-threatening medical emergency.

Pathophysiology

The airway may be partially or completely occluded. Partial obstruction of the airway can lead to progressive hypoxia, hypercarbia, and respiratory and cardiac arrest. If the airway is completely obstructed, permanent brain injury or death will occur within 3 to 5 minutes secondary to hypoxia. Air movement is absent in the presence of complete airway obstruction. Oxygen saturation of the blood decreases rapidly because obstruction of the airway prevents entry of air into the lungs. Oxygen deficit occurs in the brain, resulting in unconsciousness, with death following rapidly.

Upper airway obstruction has a number of causes, including aspiration of foreign bodies, anaphylaxis, viral or bacterial infection, trauma, and inhalation or chemical burns. For older adult patients, especially those in extended care facilities, sedative and hypnotic medications, diseases affecting motor coordination (e.g., Parkinson disease), and mental dysfunction (e.g., dementia, intellectual disability) are risk factors for asphyxiation by food. As patients grow older, atrophy of the posterior pharynx occurs, resulting in aspiration or difficulty swallowing. In adults, aspiration of a bolus of meat is the most common cause of airway obstruction. Peritonsillar abscesses, epiglottitis, and other acute infectious processes of the posterior pharynx can also result in airway obstruction. The most common causes of airway obstruction are from an allergic reaction (i.e., causing laryngospasm), infection, or angioedema (ENA, 2013).

Clinical Manifestations

Typically, a person with a foreign-body airway obstruction cannot speak, breathe, or cough. The patient may clutch the neck between the thumb and fingers (i.e., universal distress signal). Other common signs and symptoms include choking, apprehensive appearance, refusing to lie flat, inspiratory and expiratory stridor, labored breathing, the use of accessory muscles (suprasternal and intercostal retraction), flaring nostrils, increasing anxiety, restlessness, and confusion. Cyanosis and loss of consciousness, which develop as hypoxia worsens, are late signs. Action must be taken before these manifestations develop, if possible, or immediately if the patient has already exhibited these signs.

Assessment and Diagnostic Findings

Assessment of the patient who has a foreign object occluding the airway may involve simply asking the person whether he or she is choking and requires help. If the person is unconscious, inspection of the oropharynx may reveal the offending object. X-rays, laryngoscopy, or bronchoscopy also may be performed. Oxygen supplementation should be considered immediately.

Management

If the patient can breathe and cough spontaneously, a partial obstruction should be suspected. The victim is encouraged to cough forcefully and to persist with spontaneous coughing and breathing efforts as long as good air exchange exists. There may be some wheezing between coughs. If the patient demonstrates a weak, ineffective cough, high-pitched noise while inhaling, increased respiratory difficulty, or cyanosis, the patient should be managed as if there were complete airway obstruction.

After the obstruction is removed, rescue breathing is initiated. If the patient has no pulse, cardiac compressions are instituted. These measures provide oxygen to the brain, heart, and other vital organs until definitive medical treatment can restore and support normal heart and ventilatory activity (ENA, 2013). See Chapter 23 for review of current CPR guidelines.

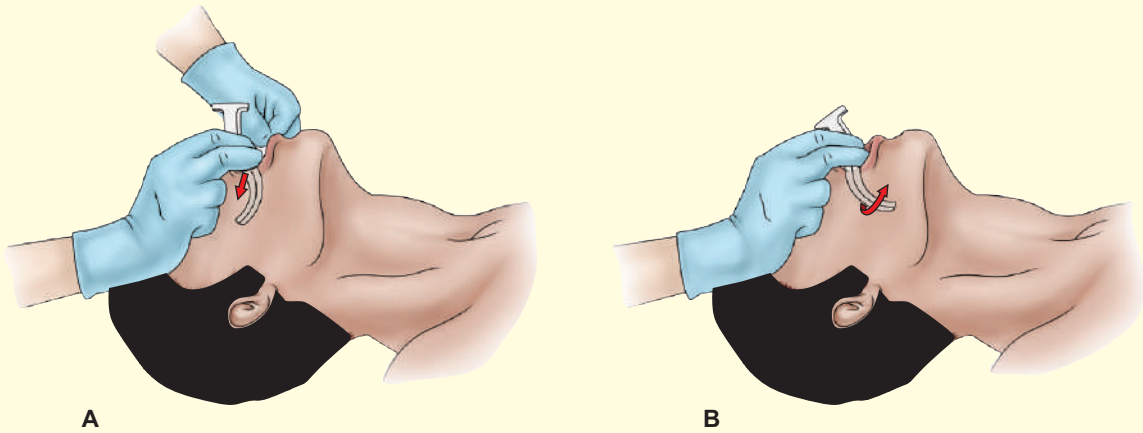
Establishing an Airway

Establishing an airway may be as simple as repositioning the patient's head to prevent the tongue from obstructing the pharynx. Alternatively, other maneuvers, such as the head-tilt/chin-lift maneuver, the jaw-thrust maneuver, or insertion of specialized equipment, may be needed to open the airway, remove a foreign body, or maintain the airway. In all maneuvers, the cervical spine must be protected from injury. After these maneuvers are performed, the patient is assessed for breathing by watching for chest movement and listening and feeling for air movement. In such a case, nursing diagnoses would include ineffective airway clearance related to obstruction of the airway by the tongue, an object, or fluids (blood, saliva) and ineffective breathing pattern related to airway obstruction or injury. See Chapter 11, Chart 11-6 for information regarding how to clear an upper airway obstruction.

Chart 60-2

Inserting an Oropharyngeal Airway

1. Measure the oral airway alongside the head. The airway should reach from lip to ear.
2. Extend the patient's head by placing one hand under the bony chin (*only if the cervical spine is uninjured*). With the other hand, tilt the head backward by applying pressure to the forehead while simultaneously lifting the chin forward.
3. Open the patient's mouth.
4. **A**. Insert the oropharyngeal airway with the tip facing up toward the roof of the mouth until it passes the uvula. **B**. Rotate the tip 180 degrees so that the tip is pointed down toward the pharynx. This displaces the tongue anteriorly, and the patient then breathes through and around the airway. An alternate method is to use a tongue blade to hold the tongue and insert the oropharyngeal airway directly without rotation.
5. The distal end of the oropharyngeal airway is in the hypopharynx, and the flange is approximately at the patient's lips. Make sure that the tongue has not been pushed into the airway.



Adapted from Walsh, K & Woten, M. (2016). Oropharyngeal airway: Inserting in adults. In D. Pravikoff (Ed.). Nursing practice and skill. Glendale, CA: CINAHL Information Systems.

Oropharyngeal/Nasopharyngeal Airway Insertion

An oropharyngeal airway is a semicircular tube or tubelike plastic device that is inserted over the back of the tongue into the lower posterior pharynx in a patient who is breathing spontaneously but who is unconscious (see Chart 60-2). This type of airway prevents the tongue from falling back against the posterior pharynx and obstructing the airway. It also allows health care providers to suction secretions. The nasopharyngeal airway provides the same airway access but is inserted through the nares. With an airway in place the patient may breathe spontaneously. If breathing is ineffective or absent, bag-valve-mask ventilation is necessary.

Nursing Alert: In the case of potential facial trauma or basal skull fracture, the nasopharyngeal airway should not be used because it could enter the brain cavity instead of the pharynx.

Endotracheal Intubation

The purpose of endotracheal intubation is to establish and maintain the airway in patients with respiratory insufficiency or hypoxia. Endotracheal intubation is indicated to establish an airway for a patient who cannot be adequately ventilated with an oropharyngeal or nasopharyngeal airway, bypass an upper airway obstruction, prevent aspiration, permit connection of the patient to a resuscitation bag or mechanical ventilator, or facilitate the removal of tracheobronchial secretions (see Fig. 60-1). Because of the level of skill required, endotracheal intubation is performed only by those who have had extensive training. These may include physicians, nurse practitioners in critical care, and respiratory therapists. However, the emergency nurse commonly assists with intubation.

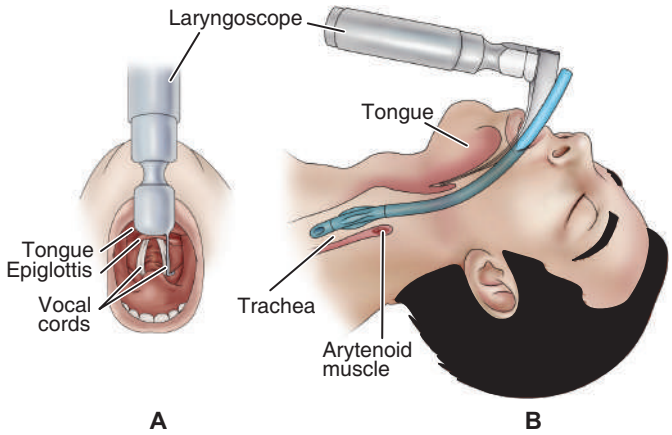


Figure 60-1 • Endotracheal intubation in a patient without a cervical spine injury. **A**. The primary glottic landmarks for tracheal intubation as visualized with proper placement of the laryngoscope. **B**. Positioning the endotracheal tube.

Rapid sequence intubation may be indicated, which provides management of the patient in a situation similar to that in the operating room. Medications used to facilitate rapid sequence intubation include a sedative, an analgesic, and a neuromuscular blockade agent; these are usually given by the practitioner performing the intubation.

Intubation with a King Tube or Laryngeal Mask Airway

If the patient is not hospitalized and cannot be intubated in the field, emergency medical personnel may insert a King Tube, which rapidly provides pharyngeal ventilation. When the tube

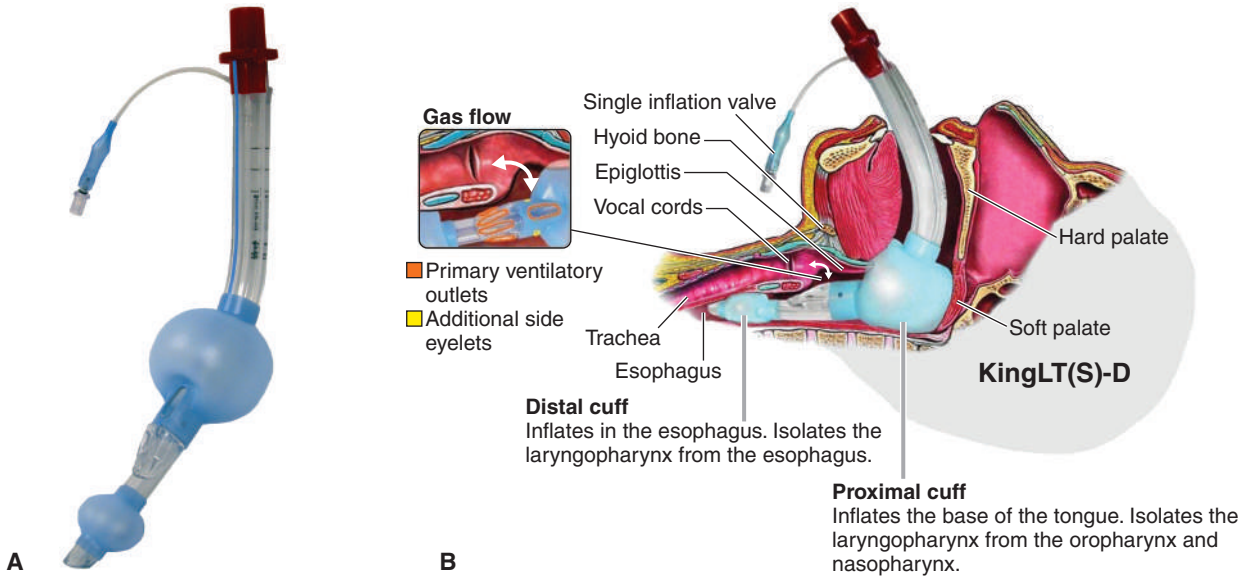


Figure 60-2 • King Tube (**A**) correctly placed in esophageal position (**B**). Reprinted with permission from King Systems Corporation, Noblesville, Indiana.

is inserted into the trachea, it functions like an endotracheal tube (see Fig. 60-2).

The two balloons that surround the tube are inflated after the tube is inserted. One balloon is large and occludes the oropharynx. This permits ventilation by forcing air through the larynx. The smaller balloon is inflated with air and occludes the esophagus at a site distal to the glottis. Breath sounds are auscultated after balloon inflation to make sure that the oropharyngeal balloon (or cuff) does not obstruct the glottis. One variant type of King Tube is designed so that a gastric tube may also be passed for suction. If it is difficult to establish an airway, a laryngeal mask airway (LMA) may be inserted as an interim airway device. The design of the LMA provides a "mask" in the subglottic airway with a cuff inflated within the esophagus. It allows easy insertion for rapid airway control until a more definitive airway can be placed. Some LMAs also permit removal of secretions from the esophagus (see Chapter 5, Fig. 5-13A).

Cricothyroidotomy (Cricothyroid Membrane Puncture)

Cricothyroidotomy is the opening of the cricothyroid membrane to establish an airway. This procedure is used in emergency situations in which endotracheal intubation is either not possible or contraindicated, as in airway obstruction from extensive maxillofacial trauma, cervical spine injuries, laryngospasm, laryngeal edema (after an allergic reaction or extubation), hemorrhage into neck tissue, or obstruction of the larynx. A cricothyroidotomy is replaced with a formal tracheostomy when the patient is able to tolerate this procedure.

Maintaining Ventilation

After the airway is determined to be unobstructed, the nurse must ensure that ventilation is adequate by checking for equal bilateral breath sounds. Satisfactory management of ventilations may prevent hypoxia and hypercapnia. The nurse must quickly assess for absent or diminished breath sounds, open chest wounds, and difficulty delivering artificial breaths for the patient. The nurse should monitor pulse oximetry, capnography, and arterial blood gases if the patient requires airway or ventilatory assistance. A tension pneumothorax can mimic hypovolemia, so ventilatory assessment precedes assessment for hemorrhage. A pneumothorax (both simple and tension) or sucking (open) chest wound is managed with a chest tube and occlusion of the sucking wound; immediate relief of increasing positive intrathoracic pressure and maintenance of adequate ventilation should occur.

HEMORRHAGE

Stopping bleeding is essential to the care and survival of patients in an emergency or disaster situation. Hemorrhage that results in the reduction of circulating blood volume is a main cause of shock. Minor bleeding, which is usually venous, generally stops spontaneously unless the patient has a bleeding disorder or has been taking anticoagulant agents. Internal hemorrhage can hide in many anatomic spaces and compartments, resulting in shock without external evidence of hemorrhage. The internal spaces and compartments that are capable of housing large amounts of blood include the retroperitoneum, pelvis, chest, and thighs (ACS, 2013).

The patient is assessed for signs and symptoms of shock: cool, moist skin (resulting from poor peripheral perfusion), decreasing blood pressure, increasing heart rate, delayed capillary refill, and decreasing urine volume (see Chapter 8). The goals of emergency management are to control the bleeding, maintain adequate circulating blood volume for tissue oxygenation, and prevent shock. Patients who hemorrhage are at risk for cardiac arrest caused by hypovolemia with secondary anoxia. Nursing interventions are carried out collaboratively with other members of the emergency health care team.

Management

Fluid Replacement

Whenever a patient is hemorrhaging—whether externally or internally—a loss of circulating blood results in a fluid volume deficit and decreased cardiac output. Therefore, fluid replacement is imperative to maintain circulation. Typically, two large-gauge IV catheters are inserted, preferably

in an uninjured extremity, to provide a means for fluid and blood replacement. Blood samples are obtained for analysis, typing, and cross-matching. Replacement fluids are given as prescribed, depending on clinical estimates of the type and volume of fluid lost. Replacement fluids may include isotonic electrolyte solutions (e.g., lactated Ringer's, normal saline), colloids, and blood component therapy.

Packed red blood cells are infused when there is massive blood loss, which may also necessitate transfusion of other blood components, including platelets and clotting factors. See Chapter 26 for full discussion of blood component therapy indications and treatment.

Nursing Alert: The infusion rate is determined by the severity of the blood loss and the clinical evidence of hypovolemia. Any blood replacement therapy should be given via warmer when possible, because administration of large amounts of blood that has been refrigerated has a core cooling effect that may lead to cardiac arrest and coagulopathy.

Control of External Hemorrhage

If a patient is hemorrhaging externally (e.g., from a wound), a rapid physical assessment is performed as the patient's clothing is cut away in an attempt to identify the area of hemorrhage. Direct, firm pressure is applied over the bleeding area or the involved artery at a site that is proximal to the wound (see Fig. 60-3). Most bleeding can be stopped or at least controlled by application of direct pressure. Otherwise, unchecked arterial bleeding results in death. A firm pressure dressing is applied, and the injured part is elevated to stop venous and capillary bleeding, if possible. If the injured area is an extremity, the extremity is immobilized to control blood loss.

A tourniquet is applied to an extremity when the external hemorrhage cannot be controlled in any other way and until surgery can be performed. The tourniquet is applied just proximal to the wound and tied tightly enough to control arterial blood flow. The patient is tagged with a skin-marking pencil or on adhesive tape on the forehead with a "T," stating the location of the tourniquet and the time applied. If the patient has suffered a traumatic amputation with uncontrollable hemorrhage, the tourniquet remains in place until the patient is in the operating room. Time of tourniquet application and removal should be documented. Tourniquet placement among military personnel with battle-associated trauma has demonstrated clear mortality reduction, although it occasionally has led to amputation or fasciotomy (Inaba, Siboni, Resnick, et al., 2015).

Control of Internal Bleeding

If the patient shows no external signs of bleeding but exhibits tachycardia, falling blood pressure, thirst, apprehension, cool and moist skin, or delayed capillary refill, internal hemorrhage is suspected. Typically, packed red blood cells, plasma, and platelets are given at a rapid rate, and the patient is prepared for more

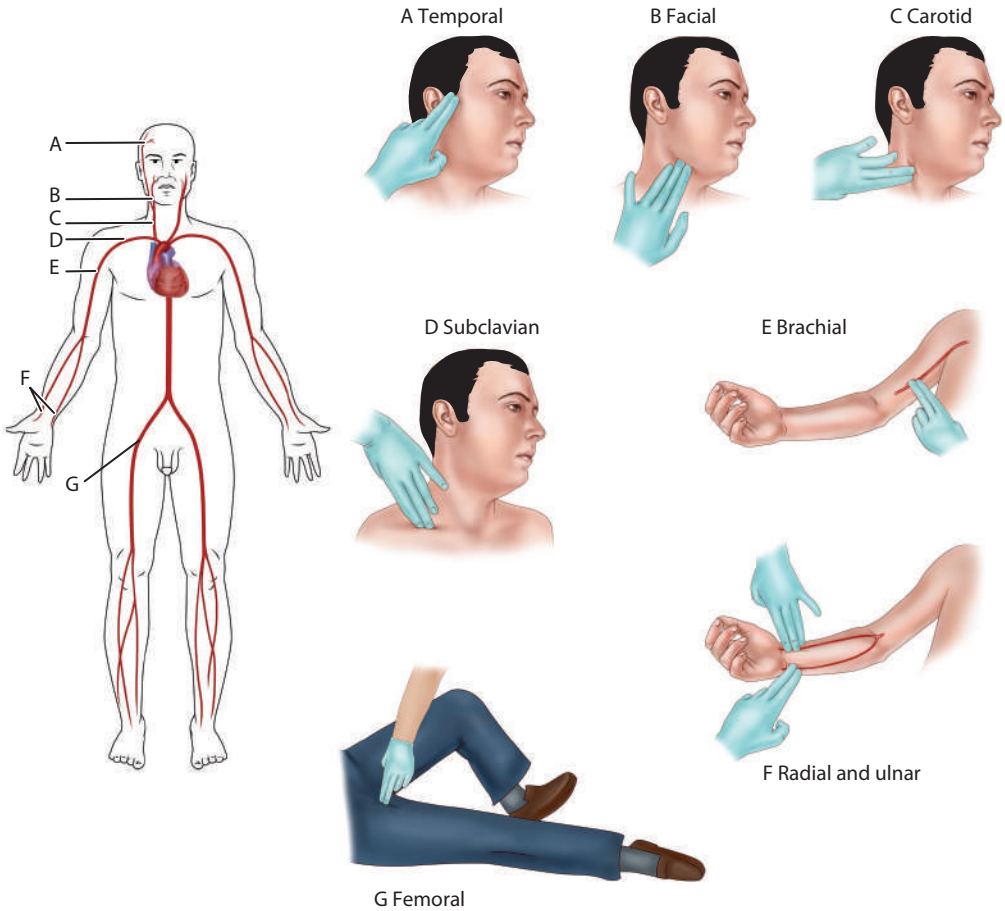


Figure 60-3 • Pressure points for control of hemorrhage.

definitive treatment (e.g., surgery, pharmacologic therapy). In addition, arterial blood gas specimens are obtained to evaluate pulmonary function and tissue perfusion and to establish baseline hemodynamic parameters, which are then used as an index for determining the amount of fluid replacement the patient can tolerate and the response to therapy. The patient is maintained in the supine position and monitored closely until hemodynamic or circulatory parameters improve, or until he or she is transported to the operating room or intensive care unit.

HYPOVOLEMIC SHOCK

Shock is a condition in which there is loss of effective circulating blood volume. Inadequate organ and tissue perfusion follows, ultimately resulting in cellular metabolic derangements. In any emergency situation, the onset of shock should be anticipated by immediately assessing all people who are injured. The underlying cause of shock (hypovolemic, cardiogenic, neurogenic, anaphylactic, or septic) must be determined. Of these, hypovolemia is the most common cause. See Chapter 8 for further discussion of management of hypovolemic shock.

WOUNDS

Wounds involving injury to soft tissues can vary from minor tears to severe crushing injuries. The types of wounds that may occur are defined in Chart 60-3. The main goal of treatment is to restore the physical integrity and function of the injured tissue while minimizing scarring and preventing infection. Proper documentation of the characteristics of the wound, using precise descriptions and correct terminology, is essential. Such information may be needed in the future for forensic evidence. Photographs are helpful because they provide an accurate, visible depiction of the wound. Photographs also become important for exigent wounds (i.e., wounds that will eventually heal). Patients involved in domestic violence or trauma may need the photographs later to visually describe the extent of injury.

Determining *when* and *how* the wound occurred is important because a treatment delay increases infection risk. Using aseptic technique, the clinician inspects the wound to determine the extent of damage to underlying structures or the presence of a foreign body. Sensory, motor, and vascular function is evaluated for changes that might indicate complications.

Chart 60-3

Definition of Terms: Wounds

Laceration: skin tear with irregular edges and vein bridging
Avulsion: tearing away of tissue from supporting structures
Abrasion: denuded skin
Ecchymosis/contusion: blood trapped under the surface of the skin
Hematoma: tumorlike mass of blood trapped under the skin
Stab: incision of the skin with well-defined edges, usually caused by a sharp instrument; a stab wound is typically deeper than long
Cut: incision of the skin with well-defined edges, usually longer than deep
Patterned: wound representing the outline of the object (e.g., steering wheel) causing the wound

Management

Wound Cleansing

Hair around the wound may be clipped (only as directed) if it is anticipated that the hair will interfere with wound closure. Typically, the area around the wound is cleansed with normal saline solution or a polymer agent (e.g., Shur-Clens). The antibacterial agent povidone-iodine (Betadine) should not be allowed to get deep into the wound without thorough rinsing. Povidone-iodine is used only for the initial cleansing because it injures exposed and healthy tissue, resulting in further tissue damage (ENA, 2013).

If indicated, the area is infiltrated with a local intradermal anesthetic through the wound margins or by regional block. Patients with soft tissue injuries usually have localized pain at the site of injury. The nurse then assists with cleaning and débriding the wound. The wound is irrigated gently and copiously with sterile isotonic saline solution to remove surface dirt. Devitalized tissue and foreign matter are removed because they impede healing and may promote infection. Any small bleeding vessels are clamped, tied, or cauterized. After wound treatment, a nonadherent dressing is applied to protect the wound and to serve as a splint and as a reminder to the patient that the area is injured.

Primary Closure

The decision to suture a wound depends on the nature of the wound, the time since the injury was sustained, the degree of contamination, and the vascularity of tissues. If primary closure is indicated, the wound is sutured or stapled, usually by the physician, with the patient receiving either local anesthesia or moderate sedation (see Chapter 5). Wound closure begins when subcutaneous fat is brought together loosely with a few sutures to close off the dead space. The subcuticular layer is then closed, and finally the epidermis is closed. Sutures are placed near the wound edge, with the skin edges leveled carefully to promote optimal healing. Instead of sutures, sterile strips of reinforced microporous tape or a bonding agent (skin glue) may be used to close clean, superficial wounds.

Delayed Primary Closure

Delayed primary closure may be indicated if tissue has been lost or there is a high potential for infection. A thin layer of gauze (to ensure drainage and prevent pooling of exudate), covered by an occlusive dressing, may be used. The wound is splinted in a functional position to prevent motion and decrease the possibility of contracture.

If there are no signs of suppuration (formation of purulent drainage), the wound may be sutured (with the patient receiving a local anesthetic). The use of antibiotic agents to prevent infection depends on factors such as how the injury occurred, the age of the wound, and the risk of contamination. The site is immobilized and elevated to limit accumulation of fluid in the interstitial spaces of the wound.

Tetanus prophylaxis is given as prescribed, based on the condition of the wound and the patient's immunization status. If the patient's last tetanus booster was given more than 5 years ago, or if the patient's immunization status is unknown, a tetanus booster must be given (ACS, 2013). The patient is instructed about signs and symptoms of infection and is instructed to contact the primary provider or clinic if there is sudden or

persistent pain, fever or chills, bleeding, rapid swelling, foul odor, drainage, or redness surrounding the wound.

TRAUMA

Trauma (an unintentional or intentional wound or injury inflicted on the body from a mechanism against which the body cannot protect itself) is the first leading cause of death in urban areas of India in the 15–29 years age group and second leading cause of death next to suicides in rural India in the same age group. It is also the sixth leading cause of death in the 30–69 years age group people in India (Causes of Death Statistics 2010–2013, Registrar General of India). Motor vehicle accidents and unintentional nonmotor vehicle injury in workplace are also major contributors.

Collection of Forensic Evidence

In assessing and managing any patient with an emergency condition, but especially the patient experiencing trauma, meticulous documentation is essential. Included in documentation are descriptions of all wounds, mechanism of injury, time of events, and collection of evidence. In trauma care, the nurse must be exceedingly careful with all potential evidence, handling and documenting it properly.

The basics of care management for patients with traumatic injury include an understanding that trauma in any patient (living or dead) has potential legal or forensic science implications if criminal activity is suspected. Hence, proper management from both a medical and forensic evidence perspective is essential.

When clothing is removed from the patient who has experienced trauma, the nurse must be careful not to cut through or disrupt any tears, holes, blood stains, or dirt present on the clothing if criminal activity is suspected. Each piece of clothing should be placed in an individual paper bag. Plastic bags are not used because they retain moisture; moisture may promote mold and mildew formation, which can destroy evidence. If the clothing is wet, it should be hung to dry. Clothing should not be given to families. Valuables should be inventoried and either placed in the hospital safe or clearly documented to which family member they were given. If a police officer is present to collect clothing or any other items from the patient, each item is labeled and the transfer of custody to the officer, the officer's name, the date, and the time are documented. Evidence cannot be left unattended in the room; a formal chain of custody must be maintained for the evidence to be valid and useful for legal purposes (Foresman-Capuzzi 2014); (Nayduch, 2009).

All deaths of patients who experienced trauma are reported to the medical examiner. If suicide or homicide is suspected in a patient who experienced trauma, the medical examiner examines the body on site or has the body moved to the mortuary for autopsy. All tubes and lines must remain in place. The patient's hands must be covered with paper bags to protect evidence on the hands or under the fingernails. In the patient who has survived trauma, tissue specimens may be swabbed from the hands and nails as potential evidence. Photographs of wounds or clothing are essential and should include a reference ruler in one photo and another without the ruler.

Documentation should also include any statements made by the patient in the patient's own words and surrounded by quotation marks. A chain of evidence is essential. If the patient's case is reviewed in a court of law in the future, clear documentation assists the judicial process and helps to identify the activities that occurred in the ED.

Injury Prevention

Any discussion of trauma management must address injury prevention. A component of the emergency nurse's daily role is to provide injury prevention information to every patient with whom there is contact, including patients admitted for reasons other than injury (Edwards, Stephens-Stidham, Contreras, et al., 2016). The only way to reduce the incidence of trauma is through prevention.

There are three components of injury prevention. The first is education. Providing information and materials to help prevent violence and to maintain safety at home and in vehicles is important. Involvement in local injury prevention organizations, nursing organizations, and health fairs promotes wellness and safety. In practice, nursing and other health care professionals should avoid using the word *accident,* because trauma events are *preventable* and should be viewed as such rather than as "fate" or "happenstance." Responsibility and accountability must be assigned to traumatic incidents, particularly because of the high rate of trauma recidivism (repeated trauma). People who are at risk for trauma and trauma recidivism should be identified and provided with education and counseling directed toward altering risky behaviors and preventing further trauma (ENA, 2013).

Second component of injury prevention is through legal action. Laws may be enacted to prevent unsafe, high speed driving; driving under the influence of alcohol; driving without helmet; etc.

The third component is automatic protection. Airbags and automotive design are included in this category. These mechanisms provide for safety without requiring personal intervention.

Multiple Trauma

Multiple trauma is caused by a single catastrophic event that causes life-threatening injuries to at least two distinct organs or organ systems. Patients with single-system trauma still receive full assessment, because even single-system injuries can be life threatening or more severe than they initially appear. Mortality in patients with multiple trauma is related to the severity of the injuries, the number of systems and organs involved, and the severity of each injury alone and in combination. Immediately after injury, the body is hypermetabolic, hypercoagulable, and severely stressed.

Care of the patient with multiple injuries requires a team approach, with one person responsible for coordinating the treatment. The nursing staff assumes responsibility for assessing and monitoring the patient, ensuring/maintaining airway and IV access, administering prescribed medications, collecting laboratory specimens, and documenting activities and the patient's subsequent responses.

Assessment and Diagnostic Findings

External evidence of trauma may be sparse or absent. Patients with multiple trauma should be assumed to have a spinal cord injury until it is proven otherwise. The injury regarded as the least significant in appearance may be the most lethal.

For example, the pelvic fracture not identified until an x-ray is obtained may cause rapid and massive hemorrhage into the pelvic cavity, but an obvious amputation of the arm may have already stopped bleeding from the body's normal response of vasoconstriction.

Management

The goals of treatment are to determine the extent of injuries and to establish priorities of treatment. Any injury interfering with a vital physiologic function (e.g., airway, breathing, circulation) is an immediate threat to life and has the highest priority for immediate treatment. Essential lifesaving procedures are performed simultaneously by the emergency team. As soon as the patient is resuscitated, clothes are removed or cut off and a rapid physical assessment is performed. Transfer from field management to the ED must be orderly and controlled, with attention and silence given to listen to the verbal report from EMS personnel. Treatment in a trauma center is appropriate for patients experiencing major trauma. Treatment priorities are presented in Chart 60-4.

Intra-Abdominal Injuries

Intra-abdominal injuries are categorized as penetrating or blunt trauma. *Penetrating* abdominal injuries (i.e., gunshot wounds, stab wounds) are serious and usually require surgery. Penetrating abdominal trauma results in a high incidence of injury to hollow organs, particularly the small bowel. The liver is the most frequently injured solid organ due to its size and anterior placement in the right upper quadrant of the abdomen. In gunshot wounds, the most important prognostic factor is the velocity at which the missile enters the body. High-velocity missiles (bullets) produce extensive tissue damage. All abdominal gunshot wounds that cross the peritoneum or are associated with peritoneal signs require surgical exploration. On the other hand, some stab wounds may be managed nonoperatively due to low velocity and less penetration of the implement (i.e., weapon) (ACS, 2013).

Blunt trauma to the abdomen may result from motor vehicle crashes, falls, blows, or explosions. Blunt trauma is commonly associated with extra-abdominal injuries to the chest, head, or extremities. Patients with blunt trauma are a challenge because injuries may be difficult to detect. The incidence of delayed and trauma-related complications is greater than for penetrating injuries. This is especially true of blunt injuries involving the liver, kidneys, spleen, or blood vessels, which can lead to massive blood loss into the peritoneal cavity (ACS, 2013).

Chart 60-4

Priority Management in Patients with Multiple Injuries

1. **Establish airway and ventilation.**



2. **Control hemorrhage.**



3. **Prevent and treat hypovolemic shock.**



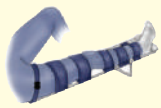
4. **Assess for head and neck injuries.**



5. **Evaluate for other injuries -** expose and reassess head and neck, chest; assess abdomen, back and extremities.



6. **Splint fractures and then reassess pulses and neurovascular status.**



7. **Perform a more thorough and ongoing examination and assessment; diagnostic studies.**



Adapted from American College of Surgeons. (2013). Advanced trauma life support (9th ed.). Chicago, IL: Author.

Assessment and Diagnostic Findings

As the history of the traumatic event is obtained, the abdomen is inspected as a part of the secondary survey for obvious signs of injury, including penetrating injuries, bruises, and abrasions. Abdominal assessment continues with auscultation of bowel sounds to provide baseline data from which changes can be noted. Absence of bowel sounds may be an early sign of intraperitoneal involvement, although stress can also decrease or halt peristalsis and thus bowel sounds. Further abdominal assessment may reveal progressive abdominal distention, involuntary guarding, tenderness, pain, muscular rigidity, or rebound tenderness along with changes in bowel sounds, all of which are signs of peritoneal irritation. Hypotension and signs and symptoms of shock may also be noted. In addition, the chest and other body systems are assessed for injuries that frequently accompany intra-abdominal injuries (ACS, 2013).

Laboratory studies that aid in assessment include the following:

- Serial hemoglobin and hematocrit levels to evaluate trends reflecting the presence or absence of bleeding
- Lactate to determine acidosis and need for continued resuscitation
- Arterial blood gas (ABG) for pH (acidosis), base deficit for resuscitation evaluation, and ventilation parameters ($PaCO_2$, PaO_2)
- International normalized ratio (INR) to identify coagulopathy or presence of chemically induced anticoagulation
- White blood cell (WBC) count to detect elevation (generally associated with trauma)

Internal Bleeding

Hemorrhage frequently accompanies abdominal injury, especially if the liver or spleen has been traumatized. Therefore, the patient is assessed continuously for signs and symptoms of external and internal bleeding. The front of the body, flanks, and back are inspected for bluish discoloration, asymmetry, abrasion, and contusion. Abdominal CT scans permit detailed evaluation of abdominal contents and retroperitoneal examination. Abdominal ultrasounds can be used to rapidly assess patients who are hemodynamically unstable to detect

intraperitoneal bleeding. This is referred to as the focused assessment with sonography for trauma (FAST) examination (ACS, 2013). During the resuscitation period, pain is managed using administration of small dosages of opioids (ACS, 2013).

Nursing Alert: The location of pain can indicate certain types of intra-abdominal injuries. Pain in the left shoulder is common in a patient with bleeding from a ruptured spleen, whereas pain in the right shoulder can result from laceration of the liver.

Intraperitoneal Injury

The abdomen is assessed for tenderness, rebound tenderness, guarding, rigidity, spasm, increasing distention, and pain. Referred pain is a significant finding because it suggests intraperitoneal injury. To determine if there is intraperitoneal injury and bleeding, the patient is usually prepared for diagnostic procedures, such as peritoneal lavage, abdominal ultrasonography, or abdominal CT scanning. Diagnostic peritoneal lavage (DPL), although no longer the standard diagnostic study used to evaluate a traumatized abdomen, remains a backup procedure that is easily performed and is very useful during mass casualty situations when CT scanners may not be readily available. DPL involves the instillation of 1 L of warmed lactated Ringer's or normal saline solution into the abdominal cavity. After a minimum of 400 mL has been returned, a fluid specimen is sent to the laboratory for analysis. Positive laboratory findings include a red blood cell count greater than 100,000/mm^3; a WBC count greater than 500/mm^3; or the presence of bile, feces, or food (ACS, 2013).

In patients with stab wounds, sinography may be performed to detect peritoneal penetration; a purse-string suture is placed around the wound and a small catheter is introduced through the wound. A contrast agent is then introduced through the catheter, and x-rays are taken to identify any peritoneal penetration.

Genitourinary Injury

A focused genitourinary examination, which typically includes a rectal and/or vaginal examination, is performed to determine any injury to the pelvis, bladder, urethra, vagina, or intestinal wall. In the male patient, a high-riding prostate gland (abnormal position) discovered during a rectal examination indicates a potential urethral injury. A digital vaginal examination is performed on female patients to determine if there is an open pelvic fracture that has torn the vagina.

Nursing Alert: To decompress the bladder and monitor urine output in a patient with a genitourinary injury, an indwelling catheter is inserted after a rectal examination has been completed, not before the examination. In addition, urethral catheter insertion when a possible urethral injury is present is contraindicated; a urology consultation and further evaluation of the urethra are required.

Management

As indicated by the patient's condition, resuscitation procedures (restoration of airway, breathing, and circulation) are initiated as described previously.

With blunt trauma, the patient is kept on a stretcher to immobilize the spine. If the patient has been placed on a backboard, it should be removed as early as possible to prevent skin breakdown. Cervical spine immobilization is maintained until cervical x-rays have been obtained and cervical spine injury has been ruled out. Likewise, once the backboard is removed, logrolling can be used to protect the spine until x-rays are obtained and confirm that there is no evidence of injuries.

Knowing the mechanism of injury (e.g., penetrating force from a gunshot or knife, blunt force from a blow) is essential to determining the type of management needed. All wounds are located, counted, and documented. If abdominal viscera protrude, the area is covered with sterile, moist saline dressings to keep the viscera from drying.

Typically, oral fluids are withheld in anticipation of surgery, and the stomach contents are aspirated with an orogastric tube to reduce the risk of aspiration and to decompress the stomach in preparation for diagnostic procedures.

Trauma predisposes the patient to infection by disruption of mechanical barriers, exposure to exogenous bacteria from the environment at the time of injury, aspiration of vomitus, and diagnostic and therapeutic procedures (hospital-acquired infection). Tetanus prophylaxis and broad-spectrum antibiotics are given as prescribed.

Throughout the stay in the ED, the patient's condition is continuously monitored for changes. If there is continuing evidence of shock, blood loss, free air under the diaphragm, evisceration, hematuria, severe head injury, musculoskeletal injury, or suspected or known abdominal injury, the patient is rapidly transported to surgery. In most cases, blunt liver and spleen injuries are managed nonsurgically. The goal for the management of all patients who have experienced trauma is to minimize the length of stay in the ED. The patient should be moved to the definitive destination quickly so that care and rehabilitation can continue.

Crush Injuries

Crush injuries occur when a person is caught between opposing forces (e.g., run over by a moving vehicle, crushed between two cars, crushed under a collapsed building).

Assessment and Diagnostic Findings

The patient is observed for the following:

- Hypovolemic shock resulting from extravasation of blood and plasma into injured tissues after compression has been released (see Chapter 8)
- Spinal cord injury (see Chapter 51)
- Erythema and blistering of skin
- Fractures (usually an extremity) (see Chapter 38)
- Acute kidney injury (acute tubular necrosis [ATN]) (see Chapter 44)

Management

In conjunction with maintaining the airway, breathing, and circulation, the patient is observed for acute kidney injury (AKI). Injury to the back can cause renal trauma (see Chapter 44). Severe muscular damage may cause rhabdomyolysis, a toxic syndrome caused by a release of myoglobin from ischemic skeletal muscle, resulting in ATN. See Chapter 44 for the treatment of AKI and ATN. Rhabdomyolysis may also result from major burns (see Chapter 47), heat stroke, and abuse of illicit drugs, in addition to crush injuries (see later discussions). The classic triad of clinical manifestations suggestive of rhabdomyolysis includes myalgias (muscle cramps), generalized muscle weakness, and

darkened urine. The serum creatine kinase (CK) is monitored as the most sensitive indicator of rhabdomyolysis; levels in excess of 6000 IU/L are considered diagnostic (Muscal & DeGuzman, 2016). In addition to treatment aimed at preventing or treating ATN, major soft tissue injuries are splinted promptly to control bleeding and pain. The serum lactic acid level is monitored; a decrease to less than 2.5 mmol/L is an indication of successful resuscitation (Blow, Magliore, Claridge, et al., 1999).

If an extremity is injured, it is elevated to relieve swelling and pressure. If compartment syndrome develops, the physician may perform a fasciotomy (i.e., surgical incision to the level of the fascia) to restore neurovascular function (see Chapter 38). Medications for pain and anxiety are then given as prescribed, and the patient is quickly transported to the operating suite for wound débridement and fracture repair. A hyperbaric oxygen chamber (if available) may be used to hyperoxygenate crushed tissue, if indicated.

Fractures

Immediate appropriate management of a fracture may determine the patient's eventual outcome and may mean the difference between recovery and disability. When the patient is being examined for fracture, the body part is handled gently and as little as possible. Clothing is cut off to visualize the affected body part. Assessment is conducted for pain over or near a bone, swelling (from blood, lymph, and exudate infiltrating the tissue), and circulatory disturbance. The patient is assessed for ecchymosis, tenderness, and crepitation (see Chapter 38). The nurse must remember that the patient may have multiple fractures accompanied by head, chest, spine, or abdominal injuries.

Management

Immediate attention is given to the patient's general condition. Assessment of airway, breathing, and circulation (which includes pulses in the extremities) is conducted. The patient is also evaluated for neurologic or abdominal injuries before the extremity is treated, unless a pulseless extremity is detected.

If a pulseless extremity is identified, repositioning of the extremity to proper alignment is required. If the pulseless extremity involves a fractured femur, Hare traction (a portable in-line traction device) may be applied to assist with alignment. If repositioning is ineffective in restoring the pulse, a rapid total-body assessment must be completed, followed by transfer of the patient to the operating room for arteriography and possible arterial repair versus amputation.

After the initial evaluation has been completed, all injuries identified are evaluated and treated. The fractured body part is inspected. Using a systematic head-to-toe approach, the nurse inspects the entire body, observing for lacerations, swelling, and deformities, including angulation (bending), shortening, rotation, and asymmetry. All peripheral pulses, especially those distal to the fractured extremity, are palpated. The extremity is also assessed for coolness, blanching, and decreased sensation and motor function, which are indicative of injury to the extremity's neurovascular supply.

A splint is applied before the patient is moved. Splinting immobilizes the joint at a site distal and proximal to the fracture, relieves pain, restores or improves circulation, prevents further tissue injury, and prevents a closed fracture from becoming an open one. To splint an extremity, one hand is placed distal to the fracture and some traction is applied while the other hand is placed beneath the fracture for support. The splints should extend beyond the joints adjacent to the fracture. Upper extremities must be splinted in a functional position. If the fracture is open, a moist, sterile dressing is applied.

After splinting, the vascular status of the extremity is checked by assessing color, temperature, pulse, and blanching of the nail bed. In addition, the patient is assessed for neurovascular compromise if pain or pressure is reported. See Chapter 38 for a complete description of fracture management.

ENVIRONMENTAL EMERGENCIES

Heat-Induced Illnesses

Heat-induced illnesses may range in severity from mild and self-limiting to life-threatening emergencies. The most serious of these—heat stroke—is an acute medical emergency caused by failure of the heat-regulating mechanisms of the body. It is the inability to maintain cardiac output in the face of moderately high body temperatures and is associated with dehydration. The most common cause of heat stroke is nonexertional, prolonged exposure to an environmental temperature of greater than 39.2°C (102.5°F), although a heat index of greater than 35°C (95°F) is associated with increased mortality (Auerbach, 2017). It usually occurs during extended heat waves, especially when they are accompanied by high humidity. Exertional heat stroke is caused by strenuous physical activity that occurs in a hot environment (Auerbach, 2017); (ENA, 2013).

People at risk for nonexertional heat stroke are those not acclimatized to heat, those who are older or very young, those unable to care for themselves, those with chronic and debilitating diseases, and those taking certain medications (e.g., major tranquilizers, anticholinergics, diuretics, beta blockers) (Tintinalli, Stapcyznski, Ma, et al., 2016); (ENA, 2013). In a study of heat-induced injury from 2006 to 2010, mortality was greater among older adults, men, and patients with pre-existing chronic illnesses. Heat-related events occurred most often in rural areas (Hess, Saha, & Luber, 2014). Exertional heat stroke occurs in healthy individuals during sports or work activities (e.g., exercising in extreme heat and humidity). Hyperthermia results because of inadequate heat loss. Strategies used to prevent heat stroke are reviewed in Chart 60-5.

Less severe forms of heat-induced illnesses include heat exhaustion and heat cramps or heat illness. The causes of heat exhaustion are the same as for heat stroke. Heat illness is caused by a loss of electrolytes, typically during strenuous physical activity in a hot environment (ENA, 2013).

Gerontologic Considerations

Most heat-related deaths occur in older adults because their circulatory systems are unable to compensate for stress imposed by heat. Older adults have a decreased ability to perspire as well as a decreased ability to vasodilate and vasoconstrict. They have less subcutaneous tissue, a decreased thirst mechanism, and a diminished ability to concentrate urine to compensate for heat. Many older adults do not drink adequate amounts of fluid, partly because of fear of incontinence, and thus have a greater risk of heat stroke. In addition, many older adults fear being victims of crime, so even if their residence lacks air conditioning, they tend to keep windows closed despite high temperatures and humidity levels (ENA, 2013).

Chart 60-5 HEALTH PROMOTION

Preventing Heat-Induced Illnesses

The nurse provides the following advice for the patient treated for heat-induced illness:

- Avoid immediate re-exposure to high temperatures; hypersensitivity to high temperatures may remain for a considerable time.
- Maintain adequate fluid intake, wear loose clothing, and reduce activity in hot weather.
- Monitor fluid losses and weight loss during workout activities or exercise and replace fluids and electrolytes.
- Use a gradual approach to physical conditioning, allowing sufficient time for return to baseline temperature.
- Plan outdoor activities to avoid the hottest part of the day (between 10 AM and 2 PM).

For older patients living in urban settings with high environmental temperatures:

- The nurse directs these patients to places where air conditioning is available (e.g., shopping mall, library, church) and advises them that fans alone are not adequate to prevent heat-induced illness.

Assessment and Diagnostic Findings

Heat stroke, whether the cause is exertional or nonexertional, causes thermal injury at the cellular level, resulting in coagulopathies and widespread damage to the heart, liver, and kidneys. Recent patient history reveals exposure to elevated ambient temperature or excessive exercise during extreme heat. When assessing the patient, the nurse notes the following symptoms: profound central nervous system (CNS) dysfunction (manifested by confusion, delirium, bizarre behavior, coma, seizures); elevated body temperature (40.6°C [105°F] or higher); hot, dry skin; and usually anhidrosis (absence of sweating), tachypnea, hypotension, and tachycardia. The patient with heat exhaustion, on the other hand, may exhibit similarly high body temperatures accompanied by headaches, anxiety, syncope, profuse diaphoresis, gooseflesh, and orthostasis. The cardinal manifestations of heat cramps include muscle cramps, particularly in the shoulders, abdomen, and lower extremities; profound diaphoresis; and profound thirst (ENA, 2013).

Management

The main goal is to reduce the high body temperature as quickly as possible, because mortality in heat stroke or morbid progression to heat stroke with less serious forms of heat-induced illnesses is directly related to the duration of hyperthermia. For the patient with heat stroke, simultaneous treatment focuses on stabilizing oxygenation using the CABs (*c*irculation, *a*irway, and *b*reathing) (formerly referred to as the ABCs) of basic life support. This includes establishing IV access for fluid administration.

After the patient's clothing is removed, the core (internal) temperature is reduced to 39°C (102°F) as rapidly as possible, preferably within 1 hour (Auerbach, 2017). One or more of the following methods may be used as prescribed (Auerbach, 2017):

- Cool sheets and towels or continuous sponging with cool water
- Ice applied to the neck, groin, chest, and axillae while spraying with tepid water
- Cooling blankets
- Immersion of the patient in a cold water bath is the optimal method for cooling (if available)

During cooling procedures, an electric fan is positioned so that it blows on the patient to augment heat dissipation by convection and evaporation. The patient's temperature is constantly monitored with a thermistor placed in the rectum, bladder, or esophagus to evaluate core temperature. Caution is used to avoid hypothermia and to prevent hyperthermia, which may recur spontaneously within 3 to 4 hours. The cooling process should stop at 38°C (100.4°F) in order to avoid iatrogenic hypothermia (ENA, 2013).

Throughout treatment, the patient's status is monitored carefully, including vital signs, ECG findings (for possible myocardial ischemia, myocardial infarction, and dysrhythmias), central venous pressure (CVP), and level of responsiveness, all of which may change with rapid alterations in body temperature. A seizure may be followed by recurrence of hyperthermia. To meet tissue needs exaggerated by the hypermetabolic condition, 100% oxygen is given. Endotracheal intubation and mechanical ventilation to support failing cardiopulmonary systems may be required.

IV infusion therapy of normal saline or lactated Ringer solution is initiated as directed to replace fluid losses and maintain adequate circulation. Fluids are given carefully because of the dangers of myocardial injury from high body temperature and poor kidney function. Cooling redistributes fluid volume from the periphery to the core.

Urine output is also measured frequently, because ATN may occur as a complication of heat stroke from rhabdomyolysis (see previous discussion). Blood specimens are obtained for serial testing to detect bleeding disorders, such as disseminated intravascular coagulation, and for serial enzyme studies to estimate thermal hypoxic injury to the liver, heart, and muscle tissue. Permanent liver, cardiac, and CNS damage may occur.

Additional supportive care may include dialysis for AKI, anticonvulsant medications to control seizures, potassium for hypokalemia, and sodium bicarbonate to correct metabolic acidosis. Benzodiazepines such as diazepam (Valium) may be prescribed to suppress seizure activity, while a phenothiazine such as chlorpromazine (Thorazine) may be prescribed to suppress shivering (Auerbach 2017); (Tintinalli et al., 2016).

Patients with heat exhaustion or heat cramps may be managed less aggressively. These patients should lie supine in a cool environment. Patients with heat exhaustion may require IV fluids but may also take oral fluids, if they are tolerated. Patients with heat cramps are given oral sodium supplements and oral electrolyte solutions (ENA, 2013). Patients who have experienced a heat-induced illness should receive education to prevent another heat-related illness (see Chart 60-5).

Frostbite

Frostbite is trauma from exposure to freezing temperatures and freezing of the intracellular fluid and fluids in the intercellular spaces. It results in cellular and vascular damage. Frostbite can result in venous stasis and thrombosis. Body parts most frequently affected by frostbite include the feet, hands, nose, and ears. Frostbite ranges from first degree (redness and erythema) to fourth degree (full-depth tissue destruction).

Assessment and Diagnostic Findings

A frozen extremity may be hard, cold, and insensitive to touch and may appear white or mottled blue-white. The extent of injury from exposure to cold is not always initially known. The patient history should include environmental temperature, duration

of exposure, clothing worn, humidity, and the presence of wet conditions. Protective clothing may partially prevent exposure to cold environments; however, wearing wet socks and exercise/movement may diminish the protective effects of insulation by 45% (Auerbach 2017); (Zafren, 2013).

Management

The goal of management is to restore normal body temperature. Constrictive clothing and jewelry that could impair circulation are removed. Wet clothing is removed as rapidly as possible. If the lower extremities are involved, the patient should not be allowed to ambulate.

Controlled yet rapid rewarming is instituted. Frozen extremities are usually placed in a 37°C to 40°C (98.6°F to 104°F) circulating bath for 30- to 40-minute spans. This treatment is repeated until circulation is effectively restored. Early rewarming appears to decrease the amount of ultimate tissue loss. During rewarming, an analgesic for pain is given as prescribed, because the rewarming process may be very painful. To avoid further mechanical injury, the body part is not handled. Massage is contraindicated.

Once rewarmed, the part is protected from further injury and is elevated to help control swelling. Sterile gauze or cotton is placed between affected fingers or toes to prevent maceration, and a bulky dressing is placed on the extremity. A foot cradle may be used to prevent contact with bedclothes if the feet are involved. Hemorrhagic blebs, which may develop 1 hour to a few days after rewarming, are left intact and not ruptured. Nonhemorrhagic blisters are débrided to decrease the inflammatory mediators found in the blister fluid.

A physical assessment is conducted with rewarming to observe for concomitant injury, such as soft tissue injury, dehydration, alcohol intoxication, or fat embolism. Problems such as hyperkalemia (e.g., from release of potassium in the damaged cells) and hypovolemia, which occur frequently in people with frostbite, are corrected. Risk of infection is also great; therefore, aseptic technique is used during dressing changes, and tetanus prophylaxis is given as indicated. Nonsteroidal anti-inflammatory drugs (NSAIDs) are prescribed for their anti-inflammatory effects and to control pain.

Additional measures that may be carried out when appropriate after emergency stabilization measures have been instituted include the following:

- Whirlpool bath for the affected body parts to aid circulation and débridement of necrotic tissue to help prevent infection
- Escharotomy (incision through the eschar) to prevent further tissue damage, to allow for normal circulation, and to permit joint motion
- Fasciotomy to treat compartment syndrome

After rewarming, hourly active motion of any affected digits is encouraged to promote maximal restoration of function and to prevent contractures. Discharge instructions also include encouraging the patient to avoid tobacco, alcohol, and caffeine because of their vasoconstrictive effects, which further reduce the already deficient blood supply to injured tissues.

Hypothermia

Hypothermia is a condition in which the core (internal) temperature is 35°C (95°F) or less as a result of exposure to cold or an inability to maintain body temperature in the absence of low ambient temperatures. Urban hypothermia (extreme exposure to cold in an urban setting) is associated with a high mortality rate; older adults, infants, people with concurrent illnesses, and those who are homeless are particularly susceptible. Alcohol ingestion increases susceptibility because it causes systemic vasodilation. Some medications (e.g., phenothiazines) or medical conditions (e.g., hypothyroidism, spinal cord injury) decrease the ability to shiver, hampering the body's innate ability to generate body heat. Fatigue and sleep deprivation are also associated with the development of hypothermia. Heat loss of 2% is normal but increases with exposure. Wet clothing accelerates heat loss, and immersion in cold water increases heat loss by 25% (ENA, 2013). Victims of trauma are also at risk for hypothermia resulting from treatment with cold fluids, unwarmed oxygen, and exposure during examination. The patient may also have frostbite, but hypothermia takes precedence in treatment.

Assessment and Diagnostic Findings

Hypothermia leads to physiologic changes in all organ systems. There is progressive deterioration, with apathy, poor judgment, ataxia, dysarthria, drowsiness, pulmonary edema, acid–base abnormalities, coagulopathy, and eventual coma. Shivering may be suppressed at a temperature of less than 32.2°C (90°F), because the body's self-warming mechanisms become ineffective. The heartbeat and blood pressure may be so weak that peripheral pulses become undetectable. Cardiac dysrhythmias may also occur. Other physiologic abnormalities include hypoxemia and acidosis.

Management

Management consists of removal of wet clothing, continuous monitoring, rewarming, and supportive care.

Monitoring

The CABs of basic life support are a priority. The patient's vital signs, CVP, urine output, arterial blood gas levels, blood chemistry determinations (blood urea nitrogen, creatinine, glucose, electrolytes), and chest x-rays are evaluated frequently. Core body temperature is monitored with an esophageal, bladder, or rectal thermistor. Continuous ECG monitoring is performed, because cold-induced myocardial irritability leads to conduction disturbances, especially ventricular fibrillation. An arterial line is inserted and maintained to record blood pressure and to facilitate blood sampling.

Rewarming

Rewarming methods include active internal (core) rewarming and passive (spontaneous) or active external rewarming.

Active internal (core) rewarming methods are used for moderate to severe hypothermia (less than 28°C to 32.2°C [82.5°F to 90°F]) and include cardiopulmonary bypass, warm fluid administration, warmed humidified oxygen by ventilator, and warmed peritoneal lavage. Monitoring for ventricular fibrillation as the patient's temperature increases from 31°C to 32°C (88°F to 90°F) is essential.

Passive or active external rewarming is used for mild hypothermia (32.2°C to 35°C [90°F to 95°F]). Passive external rewarming uses over-the-bed heaters to the extremities and increases blood flow to the acidotic, anaerobic extremities. The cold blood from peripheral tissues has high lactic acid levels. As this blood returns to the core, it causes a significant drop in the core temperature (i.e., core temperature afterdrop) and can potentially cause cardiac dysrhythmias and electrolyte

disturbances. Active external rewarming uses forced-air warming blankets. Care must be taken to prevent extremity burn from these devices, because the patient may not have effective sensation to feel the burn.

Supportive Care

Supportive care during rewarming includes the following as directed:

- External cardiac compression (typically performed only as directed in patients with temperatures higher than 31°C [88°F])
- Defibrillation of ventricular fibrillation. A patient whose temperature is less than 32°C [90°F] experiences spontaneous ventricular fibrillation if moved or touched. Defibrillation is ineffective in patients with temperatures lower than 31°C (88°F); therefore, the patient must be rewarmed first.
- Mechanical ventilation with positive end-expiratory pressure (PEEP) and heated humidified oxygen to maintain tissue oxygenation
- Administration of warmed IV fluids to correct hypotension and to maintain urine output and core rewarming, as described previously
- Administration of sodium bicarbonate to correct metabolic acidosis if necessary
- Administration of antiarrhythmic medications
- Insertion of an indwelling urinary catheter to monitor urinary output and kidney function

Nonfatal Drowning

Nonfatal drowning is defined as survival for at least 24 hours after submersion that caused a respiratory arrest. The most common consequence is hypoxemia. Children under 5 years of age and those over the age of 85 have the highest risk of drowning (CDC 2014). An estimated 372,000 drownings occur throughout the world annually, accounting for 7% of global mortality from unintentional injury (World Health Organization [WHO], 2016). Drowning and nonfatal drowning can be prevented by avoiding rip currents offshore; approximately 85% of shore drownings involve a rip current. Pool drownings can be prevented by surrounding the pool with fencing, a self-latching/closing gate, and providing swimming lessons. Supervision near water is still the best prevention measure. When boating, a personal flotation device (PFD), even for swimmers, prevents drowning events. Approximately 50% of nonfatal drownings require hospital admission for management (WHO, 2016).

Factors associated with drowning and nonfatal drowning include alcohol ingestion, inability to swim, diving injuries, hypothermia, and exhaustion. The majority of drowning events occur in pools, lakes, and bathtubs. Suicide by drowning rarely occurs in pools and rarely involves alcohol (Auerbach, 2017).

Efforts to save the patient should not be abandoned prematurely. Successful resuscitation with full neurologic recovery has occurred in patients who have experienced nonfatal drowning after prolonged submersion in cold water. This is possible because of a decrease in metabolic demands and/or the diving reflex. The nonfatal drowning process involves the onset of hypoxia, hypercapnia, bradycardia, and dysrhythmias. If there is a violent struggle associated with the nonfatal drowning episode, exercise-induced acidosis and tachypnea can result in aspiration. Hypoxia and acidosis cause eventual apnea and loss of consciousness. When the victim loses consciousness and makes a final effort to breathe, the terminal gasp occurs. Water then moves passively into the airways prior to death.

After resuscitation, hypoxia and acidosis are the major complications experienced by a person who has experienced nonfatal drowning; immediate intervention in the ED is essential. Resultant pathophysiologic changes and pulmonary injury depend on the type of fluid (fresh or salt water) and the volume aspirated. Freshwater aspiration results in a loss of surfactant and, therefore, an inability to expand the lungs. Salt-water aspiration leads to pulmonary edema from the osmotic effects of the salt within the lungs. If a person survives submersion, acute respiratory distress syndrome (ARDS), resulting in hypoxia, hypercarbia, and respiratory or metabolic acidosis, can occur.

Management

Therapeutic goals include maintaining cerebral perfusion and adequate oxygenation to prevent further damage to vital organs. Cardiopulmonary resuscitation is the factor with the greatest influence on survival. The most important priority in resuscitation is to manage the hypoxia, acidosis, and hypothermia. Prevention and management of hypoxia are accomplished by ensuring an adequate airway and respiration, thus improving ventilation (which helps correct respiratory acidosis) and oxygenation. Arterial blood gases are monitored to evaluate oxygen, carbon dioxide, bicarbonate levels, and pH. These parameters determine the type of ventilatory support needed. The use of endotracheal intubation with PEEP improves oxygenation, prevents aspiration, and corrects intrapulmonary shunting and ventilation–perfusion abnormalities (caused by aspiration of water). If the patient is breathing spontaneously, supplemental oxygen may be given by mask. However, an endotracheal tube is necessary if the patient does not breathe spontaneously.

Because of submersion, the patient is usually hypothermic. A rectal probe or other core measurement device is used to determine the degree of hypothermia. Prescribed rewarming procedures (e.g., extracorporeal warming, warmed peritoneal dialysis, inhalation of warm aerosolized oxygen, torso warming) are started during resuscitation. The choice of warming method is determined by the severity and duration of hypothermia and available resources. Intravascular volume expansion and inotropic agents are used to treat hypotension and impaired tissue perfusion. ECG monitoring is initiated, because dysrhythmias frequently occur. An indwelling urinary catheter is inserted to measure urine output. Hypothermia and accompanying metabolic acidosis may compromise kidney function. Nasogastric intubation is used to decompress the stomach and to prevent the patient from aspirating gastric contents.

Even if the patient appears healthy, close monitoring continues with serial vital signs, serial arterial blood gas values, ECG monitoring, intracranial pressure assessments, serum electrolyte levels, intake and output, and serial chest x-rays. After a nonfatal drowning, the patient is at risk for complications such as hypoxic or ischemic cerebral injury, ARDS, and life-threatening cardiac arrest. The patient is also at heightened risk for aspiration; vomiting frequently occurs in patients requiring rescue breathing and in up to 86% of patients requiring CPR (Auerbach, 2017).

Decompression Sickness

Decompression sickness, also known as "the bends," occurs in patients who have engaged in diving (lake/ocean diving),

high-altitude flying, or flying in commercial aircraft within 24 hours after diving. Its effects can be hazardous. Being aware of decompression sickness and assessing the patient properly ensures appropriate management and results in decreased morbidity.

Decompression sickness results from formation of nitrogen bubbles that occur with rapid changes in atmospheric pressure. They may occur in joint or muscle spaces, resulting in musculoskeletal pain, numbness, or hypesthesia. More significantly, nitrogen bubbles can become air emboli in the bloodstream and thereby produce stroke, paralysis, or death. Taking a rapid history about the events preceding the symptoms is essential.

Assessment and Diagnostic Findings

To identify decompression sickness, a detailed history is obtained from the patient or diving partner. Evidence of rapid ascent, loss of air in the tank, buddy breathing, recent alcohol intake or lack of sleep, or a flight within 24 hours after diving suggests possible decompression sickness. Some patients describe a perfect dive yet still have the signs and symptoms of decompression sickness, in which case they must receive treatment for the condition.

Signs and symptoms include joint or extremity pain, numbness, hypesthesia, and loss of range of motion. Neurologic symptoms mimicking those of a stroke or spinal cord injury can indicate an air embolus. Cardiopulmonary arrest can also occur in severe cases and is usually fatal. Any neurologic symptoms should be rapidly assessed. All patients with decompression sickness need rapid transfer to a hyperbaric chamber.

Management

A patent airway and adequate ventilation are established, as described previously, and 100% oxygen is given throughout treatment and transport. A chest x-ray is obtained to identify aspiration, and at least one IV line is started with lactated Ringer's or normal saline solution. Research findings suggest that among patients requiring air transport (e.g., helicopter), oxygen saturations and symptoms improve when both oxygen and IV fluids are given and the transport flight remains at low altitude (i.e., below 300 m [approximately 1000 feet]) (Oode, Yanagawa, Omori, et al., 2015).

The cardiopulmonary and neurologic systems are supported as needed. If an air embolus is suspected, the head of the bed should be lowered. If the patient's wet clothing is still present, it is removed. The patient is kept warm. Transfer to the closest hyperbaric chamber for treatment is initiated. If air transport is necessary, low-altitude flight (below 300 m) is required (Oode et al., 2015). However, the patient who is awake and alert without central neurologic deficits may be able to travel by ground ambulance or by automobile, depending on the severity of symptoms. Throughout treatment, the patient is continually assessed, and changes are documented. If aspiration is suspected, antibiotic agents and other treatment may be prescribed.

Animal and Human Bites

Bites are a common reason for visits to the ED. Dog bites constitute 80% to 90% of these bites and are responsible for the majority of deaths from bites by a nonvenomous animal (Tintinalli et al., 2016). Cat bites have a high risk of infection because of the presence of *Pasteurella* in their saliva. All animal bites must be reported to public health authorities, which must provide follow-up screening of the offending animal for rabies. If the animal cannot be located and rabies vaccination verified, rabies prophylaxis for the person who has been bitten must be instituted (ENA, 2013). As per WHO, every year nearly 23,000–25,000 people die owing to rabies in Southeast Asian countries. Around 19,000 deaths were reported in India due to rabies annually. Bangladesh reported 2000 deaths per annum due to rabies (Marathe & Kumar, 2016). Although all animal bites can cause rabies, dog bite is a major cause of rabies in India. Dog bite contributes to 91.5% animal bites and out of which 60% are stray dog bites. The incidence rate of dog bite in India is 17.4 per 1000 population (Menezes, 2008).

The Govt. of India has launched the National Rabies Control Program from the 12th five-year plan period (2012–2017). The National Institute of Disease Control, Delhi, has given out guidelines for the management of bite victims. Dog bite or animal bite which causes rabies is 100% preventable, but if not managed properly it can become 100% fatal. The guidelines insist on postexposure prophylaxis for those bitten by animals and preexposure prophylaxis for those who handle human being with fully evolved rabies or animal handlers, veterinarians, world life wardens, animal catchers, and travelers from rabies free area to rabies endemic area such as India.

Classification and Management of Bite Wound

Based on the extent and exposure the management differs. The bite wound is classified into three as follows (National Center for Disease Control (NCDC) Guidelines, 2015):

Category I: Touching or licking of intact skin by rabid animals or rabies-infected person—No need of any treatment.

Category II: Nibbling of skin or minor abrasions—Wound cleansing with copious water immediately and antirabies vaccination: 0 day, 3rd day, 7th day, 14th day, and 28th day.

Category III: Wound may be only one or numerous skin bites or scratches, licks on broken skin or mucous membrane, contamination with saliva. Wild animal bite of any extent needs to be considered as a Category III wound.

Treatment of Category III Wound:

1. Cleansing with soap and water/normal saline
2. Antirabies serum or antirabies immunoglobulin: Usually antirabies serum containing immunoglobulins should be given as close as to the bite wound. Antirabies serum should not be given after 14 days of dog bite with vaccination schedule going on as it interferes with antibody production
3. Administration of antirabies vaccination on 0, 3rd, 7th, 14th, and 28th day. Both intramuscular and intradermal vaccines are available in India. As per the preparatory guidelines, vaccines should be preserved and administered.

Human bites are frequently associated with rapes, sexual assaults, or other forms of battery. The human mouth contains more bacteria than that of most other animals, so a high risk of bite-related infection exists. Depending on the circumstances surrounding the event, the victim may delay seeking treatment. The ED nurse should inspect any bitten tissue for pus, erythema, or necrosis. A health care provider should take photographs, which can be used as evidence in criminal and legal proceedings. Guidelines for collecting forensic evidence for photographing with and without a measuring device should be followed. Cleansing with soap and water is then necessary, followed by the administration of antibiotics and tetanus toxoid as prescribed (Tintinalli et al., 2016).

Snakebites

Across the globe, more than 400,000 snakebites occur each year with a 5% mortality rate (Smith, Sammons, Carr, et al. 2014). Children between 1 and 9 years of age are the most likely victims. Dry bites are bites by poisonous snakes but without venom deposition (Tintinalli et al., 2016). In the Southeast Asian countries, cobras, Russell viper, pit viper, and kraits are common poisonous snakes. The estimated deaths owing to snakebite in India are 50,000 per year, which is definitely an underestimate because of the lack of proper registration of snakebite. The population at risk of snakebite in India is around 50 million people (Ghosh, Mukhopadhyay, & Chatterjee, 2016). Similarly, in all the South Asian countries, the mortality rate due to snakebite is higher. It occurs mostly during the monsoon seasons and at night or in dim light. The Indian states of Uttar Pradesh, Andhra Pradesh, Bihar, West Bengal, Maharashtra, and Tamil Nadu report snakebites commonly (Ghosh et al., 2016). Venomous snakebites are medical emergencies.

Pathophysiology

Snake venom consists primarily of proteins and has a broad range of physiologic effects. It may affect multiple organ systems, especially the neurologic, cardiovascular, and respiratory systems.

The envenomation effect depends on the type of snake and the amount of toxins. The cobra bites are primarily cardiotoxic and neurotoxic in nature whereas the Russell viper and Pit viper produce nephrotoxic effects and lead to acute kidney injury. Even if the antivenom is injected within 1 hour, it cannot prevent acute kidney insult. Procoagulase and hyaluronidase produce massive hemorrhage and disseminated intravascular coagulation. The local effect at the site of injury is due to the direct release of cytotoxin and myotoxin that lead to necrosis and endothelial injury and persistent bleeding (Warrell, 2016; Ghosh, et al., 2016). The pathophysiology of snake envenomation is presented in Figure 60-4.

Clinical Manifestations

Classic clinical signs of envenomation are edema, ecchymosis, and hemorrhagic bullae, leading to necrosis at the site of envenomation. Symptoms include lymph node tenderness, nausea, vomiting, numbness, and a metallic taste in the mouth. Without decisive treatment, these clinical manifestations may progress to include fasciculations, hypotension, paresthesias, seizures, and coma (Smith et al., 2014). Systemic effects manifest as profound hypotension, tachycardia, ECG changes, respiratory difficulty, ptosis, ophthalmoplegia, dark colored urine or anuria, bleeding disturbances, bilateral parotid edema, facial edema, hemoglobinuria, and myoglobinuria, which is responsible for dark-colored urine (Warrell, 2016; Ghosh et al., 2016).

Management

Initial first aid at the site of the snakebite includes having the person lie down, removing constrictive items such as rings, providing warmth, cleansing the wound, covering the wound with a light sterile dressing, and immobilizing the injured body part below the level of the heart. Airway, breathing, and circulation are the priorities of care. Ice, incision and suction, or a tourniquet is *not* applied. Tetanus and analgesia should be given as necessary. Initial evaluation in the ED is performed quickly and includes information about the following:

- Whether the snake was venomous or nonvenomous; discourage bringing the snake for identification—even a dead snake's venom is poisonous. Do *not* handle any snake brought to the ED. If the snake is transported to the ED, caution should be taken because the snake is frequently in a stunned, not dead, state. The bite reflex can remain intact for up to 90 minutes after the death of the snake (Auerbach, 2017).
- Where and when the bite occurred and the circumstances of the bite.
- Sequence of events, signs, and symptoms (fang punctures, pain, edema, and erythema of the bite and nearby tissues).
- Vital signs.
- Circumference of the bitten extremity or area at several points. The circumference of the extremity that was bitten is compared with the circumference of the opposite extremity.
- Laboratory data (complete blood count, urinalysis, and coagulation studies).

The course and prognosis of snakebite injuries depend on the kind and amount of venom injected; where on the body the bite occurred; and the general health, age, and size of the patient. There is no one specific protocol for treatment of snakebites. In general, ice, tourniquets, heparin, and corticosteroids are not used during the acute stage. Corticosteroids are contraindicated

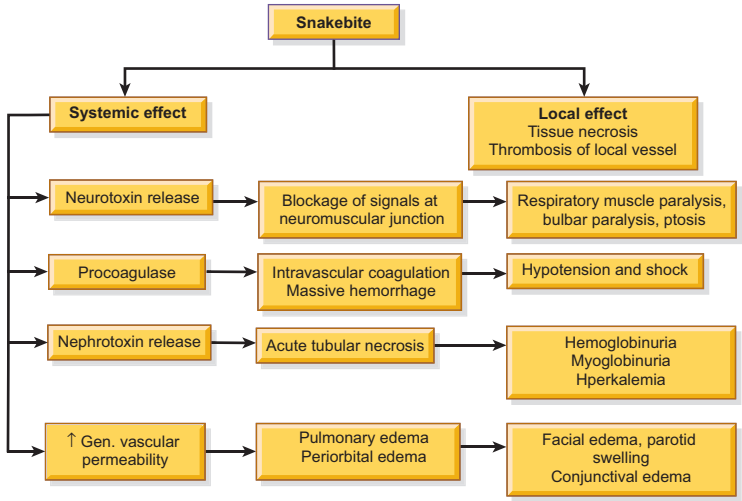


Figure 60-4 • Pathophysiology of snake envenomation.

in the first 6 to 8 hours after the bite because they may depress antibody production and hinder the action of antivenin (antitoxin manufactured from the snake venom and used to treat snakebites).

Parenteral fluids may be used to treat hypotension. If vasopressors are used to treat hypotension, their use should be short term. Surgical exploration of the bite is rarely indicated. Typically, the patient is observed closely for at least 6 hours. The patient is *never* left unattended.

Administration of Antivenin (Antitoxin)

Although envenomation does not always occur, it should always be suspected with snakebites. An assessment of progressive signs and symptoms is essential before considering administration of antivenin, which is most effective if given within 4 hours and no greater than 12 hours after the snakebite. The decision to administer antivenin depends on worsening tissue injury and evidence of systemic and coagulopathic symptoms. Rattlesnakes are more likely to cause coagulation abnormalities as well as more systemic effects. Coagulation abnormalities are not restricted to severe envenomation (Auerbach, 2017).

The most readily available antivenin in the United States is Crotalidae polyvalent immune Fab antivenom (FabAV or CroFab) (Auerbach, 2017). In India, the polyvalent antivenom serum available is effective against the four common poisonous snake species namely the cobra (Naja naja), Russel viper (*Daboia russelii*), common krait (*Bungarus caeruleus*), and saw-scaled viper (*Echis carinatus*). The dose depends on the type of snake and the estimated severity of the bite. Indications for antivenin depend on the progression of symptoms, including coagulopathy and systemic reaction.

Before administering antivenin and every 15 minutes thereafter, the circumference of the affected part is measured. Premedication with diphenhydramine (Benadryl) or cimetidine (Tagamet) may be indicated, because these antihistamines may decrease the allergic response to antivenin. Antivenin is given as an IV infusion whenever possible, although intramuscular administration can be used.

Depending on the severity of the snakebite, the antivenin is diluted in 500 to 1000 mL of normal saline solution. The infusion is started slowly, and the rate is increased after 10 minutes if there is no reaction. The total dose should be infused during the first 4 to 6 hours after the bite. The initial dose is repeated until symptoms decrease, after which time the circumference of the affected part should be measured every 30 to 60 minutes for the next 48 hours to detect symptoms of compartment syndrome (swelling, loss of pulse, increased pain, and paresthesias).

There is no limit to the number of antivenin vials that can be given. The decision to continue to administer vials is based upon patient symptoms. The most common cause of allergic reaction to the antivenin is too-rapid infusion. Reactions may consist of a feeling of fullness in the face, urticaria, pruritus, malaise, and apprehension. These symptoms may be followed by tachycardia, shortness of breath, hypotension, and shock. In this situation, the infusion should be stopped immediately and IV diphenhydramine given. Vasopressors (Inj. Adrenaline) are used for patients in shock, and resuscitation equipment must be on standby while antivenin is infusing. It is important to note that serum sickness (hypersensitivity) can occur within the first few weeks after discharge. The patient and the patient's family members should be educated about the clinical manifestations of serum sickness (i.e., fever; rash starting on the chest and spreading to the back; arthralgia; GI disturbances [e.g., nausea, vomiting, diarrhea, abdominal pain], and headache) and return to the ED if they occur (Auerbach, 2017); (Tintinalli et al., 2016).

In case of neurotoxic envenomation as in cobra bite, Inj. Neostigmine in the dose of 0.04 mg/kg IV, Inj. Atropine, Inj. Glycopyrrolate may be prescribed as continuous infusion to prolong the effect of acetylcholine and thereby reverse the respiratory failure and neurotoxic symptoms (Ghosh, et al., 2016).

Tick Bites

Tick bites are common in, and they usually occur in grassy or wooded areas. It is important to learn the place where the bite occurred as well as the location of the bite on the body. The tick bite itself is not usually the problem; rather, it is the pathogen transmitted by the tick that can cause serious disease. Ticks can carry diseases such and Lyme disease.

Ticks transmit pathogens through their saliva; therefore, the earlier the tick is removed, the better the prognosis. The tick should be removed with tweezers using a straight upward pull (see Fig. 60-5), and the patient should be informed of the signs and symptoms of diseases carried by ticks, especially if the patient lives in or has visited an area endemic for tick-related diseases (e.g., Lyme disease) (Auerbach 2017); (ENA, 2013).

Lyme disease has three stages. Stage I may present with a classic "bull's-eye" rash (i.e., erythema migrans) that typically can be found in the axilla, groin, or thigh area and that appears within 4 weeks after the tick bite, with a peak manifestation time of 7 days after the bite. Classically, this rash is at least 5 cm in diameter with bright red borders. It is accompanied by flulike signs and symptoms that may include chills, fever, myalgia, fatigue, and headache. Without treatment, the rash subsides within 3 to 4 weeks. However, the rash and flulike manifestations can be significantly reduced within days if prompt treatment with antibiotic agents (e.g., doxycycline [Vibramycin]) is initiated. If antibiotics are not given, stage II Lyme disease may present within 4 to 10 weeks following the tick bite and may manifest with joint pain, memory loss, poor motor coordination, adenopathy, and cardiac abnormalities. Facial nerve palsy is the most common manifestation of stage II Lyme disease (Tintinalli et al., 2016). Stage III can begin anywhere from weeks to more than a year after the bite and has serious long-term chronic sequelae, including arthritis, neuropathy, myalgia, and myocarditis. Even after appropriate treatment with antibiotics, 10% to 20% of patients may experience long-term effects including fatigue and arthralgias; some experience neurologic symptoms that may persist for over 10 years (Tintinalli et al., 2016).

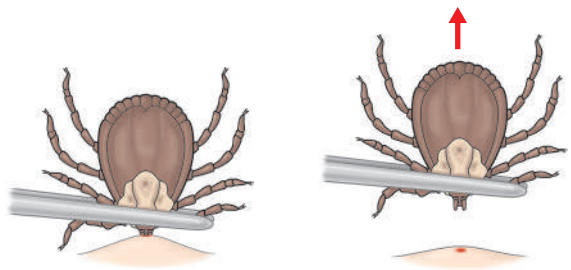


Figure 60-5 • Removal of tick with tweezers using a straight upward pull.

POISONING

- A poison is any substance that, when ingested, inhaled, absorbed, applied to the skin, or produced within the body in relatively small amounts, injures the body by its chemical action. Poisoning from inhalation and ingestion of toxic materials, both intentional and unintentional, constitutes a major health hazard and an emergency situation. Removal or inactivation of the poison before it is absorbed
- Provision of supportive care in maintaining vital organ function
- Administration of a specific antidote to neutralize a specific poison
- Implementation of treatment that hastens the elimination of the absorbed poison

Ingested (Swallowed) Poisons

Swallowed poisons may be corrosive. Corrosive poisons include alkaline and acid agents that can cause tissue destruction after coming in contact with mucous membranes. Alkaline products include lye, drain cleaners, toilet bowl cleaners, bleach, nonphosphate detergents, oven cleaners, and button batteries (batteries used to power watches, calculators, hearing aids, or cameras). Acid products include toilet bowl cleaners, pool cleaners, metal cleaners, rust removers, and battery acid.

Control of the airway, ventilation, and oxygenation are essential. In the absence of cerebral or renal damage, the patient's prognosis depends largely on successful management of respiration and circulation. Measures are instituted to stabilize cardiovascular and other body functions. ECG, vital signs, and neurologic status are monitored closely for changes. Shock may result from the cardiodepressant action of the substance ingested, from venous pooling in the lower extremities, or from reduced circulating blood volume resulting from increased capillary permeability (see Chapter 8). An indwelling urinary catheter is inserted to monitor kidney function. Blood specimens are obtained to determine the concentration of drug or poison.

Efforts are made to determine what substance was ingested; the amount; the time since ingestion; signs and symptoms, such as pain or burning sensations, any evidence of redness or burn in the mouth or throat, pain on swallowing or an inability to swallow, vomiting, or drooling; age and weight of the patient; and pertinent health history.

Measures are instituted to remove the toxin or decrease its absorption. If there is a specific chemical or physiologic antagonist (antidote), it is given as early as possible to reverse or diminish the effects of the toxin. If this measure is ineffective, procedures may be initiated to remove or dilute the ingested substance. These procedures include administration of multiple doses of activated charcoal, dialysis, or hemoperfusion. Hemoperfusion involves detoxification of the blood by processing it through an extracorporeal circuit and an adsorbent cartridge containing charcoal or resin, after which the cleansed blood is returned to the patient.

The patient who has ingested a corrosive poison, which can be a strong acid or alkaline substance, is given water or milk to drink for dilution. However, dilution is not attempted if the patient has acute airway edema or obstruction; potential for vomiting; or if there is clinical evidence of esophageal, gastric, or intestinal burn or perforation. The following gastric emptying procedures may be used as prescribed:

- Gastric lavage for the patient who is obtunded is only useful within 1 hour of ingestion, for sustained-release substances, or massive life-threatening amounts of a substance; however, complications of aspiration and stomach or esophageal perforation outweigh its usefulness. If performed, gastric aspirate is saved and sent to the laboratory for testing (toxicology screens).
- Activated charcoal administration if the poison is one that is absorbed by charcoal; given orally or by nasogastric tube, it is effective in small intermittent doses to decrease vomiting. It should be diluted as a slurry so that it is easier to drink or pass through the nasogastric tube. Activated charcoal absorbs most commonly ingested poisons except corrosives, heavy metals and hydrocarbons, iron, and lithium.

Cathartics, which had traditionally accompanied the use of activated charcoal, are now rarely indicated because they can result in severe electrolyte imbalances, diarrhea, and hypovolemia (ENA, 2013). Furthermore, syrup of ipecac to induce vomiting in the patient who is alert is not recommended due to the risk of aspiration and should *never* be used with corrosive poisons or with petroleum distillates (e.g., lubricating oil, fuel oil) or further corrosive damage to the upper airway and pharyngeal structures may occur.

Nursing Alert: Vomiting is never induced after ingestion of caustic substances (acid or alkaline) or petroleum distillates.

Throughout detoxification, the patient's vital signs, CVP, and fluid and electrolyte balance are monitored closely. Hypotension and cardiac dysrhythmias are possible. Seizures are also possible because of CNS stimulation from the poison or from oxygen deprivation. If the patient complains of pain, analgesic agents are given cautiously. Severe pain causes vasomotor collapse and reflex inhibition of normal physiologic functions.

After the patient's condition has stabilized and discharge is imminent, written material should be given to the patient indicating the signs and symptoms of potential problems related to the poison ingested and signs or symptoms requiring evaluation by a health care provider. If poisoning was determined to be a suicide or self-harm attempt, a psychiatric consultation should be requested before the patient is discharged. In cases of inadvertent poison ingestion, poison prevention and home poison-proofing instructions should be provided to the patient and family.

Legal Implications while Caring for Poisoning Patients

All types of poisoning is considered as medicolegal case and emergency medical officer or medical director has to intimate it to the nearby police station on admission of such patients. All records and evidences pertaining to the patient also have to be preserved safely. In case of death of the patient owing to poison, the same police officers need to be informed. The deceased body will be handed over to police for further investigation and autopsy. Emergency treatment is initiated with the following goals.

- Removal or inactivation of the poison before it is absorbed
- Provision of supportive care in maintaining vital organ function
- Administration of a specific antidote to neutralize a specific poison
- Implementation of treatment that hastens the elimination of the absorbed poison

Carbon Monoxide Poisoning

Carbon monoxide poisoning may occur as a result of industrial or household incidents or attempted suicide. It is the most common cause of fatality from poisoning and is frequently under-reported to poison control centers or misdiagnosed (Tintinalli et al., 2016). Carbon monoxide exerts its toxic effect by binding to circulating hemoglobin and thereby reducing the oxygen-carrying capacity of the blood. Hemoglobin absorbs carbon monoxide 200 times more readily than it absorbs oxygen. Carbon monoxide–bound hemoglobin, called carboxyhemoglobin, does not transport oxygen.

Clinical Manifestations

Because the CNS has a critical need for oxygen, CNS symptoms predominate with carbon monoxide toxicity. A person with carbon monoxide poisoning may appear intoxicated (from cerebral hypoxia). Other signs and symptoms include headache, muscular weakness, palpitation, dizziness, and confusion, which can progress rapidly to coma. Skin color, which can range from pink or cherry-red to cyanotic and pale, is not a reliable sign. Pulse oximetry may reveal a high hemoglobin saturation, which may be deceiving, since the hemoglobin molecule is saturated with carbon monoxide rather than oxygen (ENA, 2013).

Management

Exposure to carbon monoxide requires immediate treatment. Goals of management are to reverse cerebral and myocardial hypoxia and to hasten elimination of carbon monoxide. Whenever a patient inhales a poison, the following general measures apply:

- Carry the patient to fresh air immediately; open all doors and windows.
- Loosen all tight clothing.
- Initiate traditional cardiopulmonary resuscitation.
- Prevent chilling; wrap the patient in blankets.
- Keep the patient as quiet as possible.
- Do not give alcohol in any form or permit the patient to smoke.

In addition, for the patient with carbon monoxide poisoning, carboxyhemoglobin levels are analyzed on arrival at the ED and before treatment with oxygen if possible. To reverse hypoxia and accelerate the elimination of carbon monoxide, 100% oxygen is given at atmospheric or preferably hyperbaric pressures. Oxygen is given until the carboxyhemoglobin level is less than 5%. The patient is monitored continuously. Psychoses, spastic paralysis, ataxia, visual disturbances, and deterioration of mental status and behavior may persist after resuscitation and may be symptoms of permanent brain damage (Tintinalli et al., 2016).

A psychiatric consultation is warranted if it has been determined that the poisoning was a suicide attempt.

Skin Contamination Poisoning (Chemical Burns)

Skin contamination injuries from exposure to chemicals are challenging because of the large number of possible offending agents with diverse actions and metabolic effects. The severity of a chemical burn is determined by the mechanism of action, the penetrating strength and concentration, and the amount and duration of exposure of the skin to the chemical.

The skin should be drenched immediately with running water from a shower, hose, or faucet, except in the case of lye and white phosphorus, which should be brushed off the skin dry (Moore, 2015).

Nursing Alert: Water should not be applied to burns from lye or white phosphorus because of the potential for an explosion or for deepening of the burn. All evidence of these chemicals should be brushed off the patient before any flushing occurs.

The skin should be flushed with a constant stream of water as the patient's clothing is removed. The skin of health care personnel assisting the patient should be appropriately protected if the burn is extensive or if the agent is significantly toxic or still present. Prolonged lavage with generous amounts of tepid water is important. The decontamination shower (deluge) in the ED is the optimal place for total body flushing. The staff attending the patient should wear proper personal protective equipment (PPE) to prevent cross-contamination (Moore, 2015).

Attempts to determine the identity and characteristics of the chemical agent are necessary in order to specify future treatment. The standard burn treatment appropriate for the size and location of the wound (antimicrobial treatment, débridement, tetanus prophylaxis, antidote administration as prescribed) is instituted (Moore, 2015) (see Chapter 47). The patient may require plastic surgery for further wound management. The patient is instructed to have the affected area reexamined at 24 and 72 hours and in 7 days because of the risk of underestimating the extent and depth of these types of injuries.

Food Poisoning

Food poisoning is a sudden illness that occurs after ingestion of contaminated food or drink. Botulism is a serious form of food poisoning that requires continual surveillance (see Chapter 61, Table 61-5). Assessment questions for patients with food poisoning are discussed in Chart 60-6.

The key to treatment is determining the source and type of food poisoning. If possible, the suspected food should be brought to the medical facility and a history obtained from the patient or family.

Food, gastric contents, vomitus, serum, and feces are collected for examination. The patient's respirations, blood pressure, level of consciousness (LOC), CVP (if indicated), and muscular activity are monitored closely. Measures are instituted

Chart 60-6 ASSESSMENT

Food Poisoning

Use the following questions to elicit information about the circumstances surrounding the possibility of food poisoning:

- How soon after eating did the symptoms occur? (Immediate onset suggests chemical, plant, or animal poisoning.)
- What was eaten in the previous meal? Did the food have an unusual odor or taste? (Most foods causing bacterial poisoning *do not* have unusual odor or taste.)
- Did anyone else become ill from eating the same food?
- Did vomiting occur? What was the appearance of the vomitus?
- Did diarrhea occur? (Diarrhea is usually absent with botulism and with shellfish or other fish poisoning.)
- Are any neurologic symptoms present? (These occur in botulism and in chemical, plant, and animal poisoning.)
- Does the patient have a fever? (Fever is characteristic in salmonella, ingestion of fava beans, and some fish poisoning.)

to support the respiratory system. Death from respiratory paralysis can occur with botulism, fish poisoning, and some other food poisonings.

Because large volumes of electrolytes and water are lost by vomiting and diarrhea, fluid and electrolyte status should be assessed. Severe vomiting produces alkalosis, and severe diarrhea produces acidosis. Hypovolemic shock may also occur from severe fluid and electrolyte losses. The patient is assessed for signs and symptoms of fluid and electrolyte imbalances, including lethargy, rapid pulse rate, fever, oliguria, anuria, hypotension, and delirium. Baseline weight and serum electrolyte levels are obtained for future comparisons.

Measures to control nausea are also important to prevent vomiting, which could exacerbate fluid and electrolyte imbalances. An antiemetic medication is given parenterally as prescribed if the patient cannot tolerate fluids or medications by mouth (Tintinalli et al., 2016). For mild nausea, the patient is encouraged to take sips of weak tea, carbonated drinks, or tap water. After nausea and vomiting subside, clear liquids are usually prescribed for 12 to 24 hours, and the diet is gradually progressed to a low-residue, bland diet.

SUBSTANCE ABUSE

Substance abuse is the misuse of specific substances, such as drugs or alcohol, to alter mood or behavior. Drug abuse is the use of drugs for other than legitimate medical purposes. People who abuse drugs often take a variety of drugs simultaneously (such as alcohol, barbiturates, opioids, and tranquilizers), and the combination may have additive and addictive effects.

One of the most commonly used drugs is 3,4-methylenedioxymethamphetamine (MDMA), or Ecstasy, a methamphetamine-based drug that users believe produces a "harmless high."

Spice is a synthetic cannabinoid sold commercially as a smoking mixture under the names "spice," "incense," or "K2." Its chemical structure and effects are similar to marijuana, targeting the same receptor sites in the brain. Spice is sold with variable concentrations and unregulated potency (National Institute on Drug Abuse, 2015b).

Bath salts are synthetic stimulants similar to Ecstasy known as "mephedrone," "drone," or "MCAT." Their effects are similar to amphetamines, MDMA, and cocaine. Although bath salts are most commonly swallowed or snorted, they may also be smoked or injected; the method of intake affects the severity and duration of effects (Table 60-1). The structural formula 3,4-methylenedioxypyrovalerone (MDPV) is the most common type of bath salt abused (Baumann, Partilla, Lehner, et al., 2013).

Abuse of various inhalants (see Table 60-1) has also increased in popularity; these products generally result more often in cravings than withdrawal when their use is stopped. The method of inhalation varies with the product chosen and requires several deep inhalations to reach euphoria. Methods include sniffing or snorting by directly inhaling the fumes. "Bagging" (from a bag) or "huffing" (from a rag or cloth) provide the greatest concentration; "dusting" is another method that delivers the inhalant by directly spraying it into the nostrils. Long-term use results in cortical atrophy and brainstem dysfunction, in addition to cardiomyopathy and emphysema-like abnormalities of the lung. Significant others or parents may report that the patient has had poor school or work performance or attendance, weight loss, poor hygiene, fatigue, nosebleeds, and decreased appetite (ENA 2013).

Clinical manifestations vary with the substance used, but the underlying principles of management are essentially the same. Table 60-1 identifies commonly abused drugs, listing their clinical manifestations and therapeutic management. Treatment goals for a patient with a drug overdose are to support the respiratory and cardiovascular functions, to enhance clearance of the agent, and to provide for safety of the patient and staff. People who abuse IV/injection drugs are at increased risk for HIV infection, acquired immune deficiency syndrome, hepatitis B and C, and tetanus.

Acute Alcohol Intoxication

Alcohol is a psychotropic drug that affects mood, judgment, behavior, concentration, and consciousness. Many people who drink heavily are young adults or those older than 60 years. There is a high prevalence of alcoholism among patients presenting to the ED for management; up to 31% have histories of alcohol abuse. Among patients who present to the ED with various injuries, up to 50% may have histories of alcohol abuse (ENA 2013). Because patients who abuse alcohol return frequently to the ED, they present a challenge to the health professionals who care for them. The CDC advocates routine screening for alcohol abuse in all outpatient settings, including EDs. Therefore, screenings, brief interventions, and referral to treatment (SBIRT) for patients presenting with suspected alcohol abuse are recommended. SBIRT is considered cost-effective in saving quality of life-years lost and preventing the morbid consequences of continued alcohol abuse (Kane, Mitchell, Aiello, et al., 2016); (Slain, Rickard-Aasen, Pringle, et al., 2014).

Alcohol, or ethanol, is a multisystem toxin and CNS depressant that causes drowsiness, impaired coordination, slurring of speech, sudden mood changes, aggression, belligerence, grandiosity, and uninhibited behavior. In excess, it can also cause stupor and eventually coma and death (i.e., alcohol poisoning). Increasingly, underage minors and college students arrive at the ED with alcohol poisoning from binge drinking.

In the ED, the patient who is intoxicated with alcohol or who presents with alcohol poisoning is assessed for head injury, hypoglycemia (which mimics intoxication), and other health problems. Possible nursing diagnoses include ineffective breathing pattern related to CNS depression and ineffective impulse control related to severe intoxication from alcohol.

Treatment involves detoxification of the acute poisoning, recovery, and rehabilitation. Commonly, the patient uses mechanisms of denial and defensiveness. The nurse should approach the patient in a nonjudgmental manner, using a firm, consistent, accepting, and reasonable attitude. Speaking in a calm and slow manner is helpful because alcohol interferes with thought processes. If the patient appears intoxicated, hypoxia, hypovolemia, and neurologic impairment must be ruled out before it is assumed that the patient is intoxicated. Typically, a blood specimen is obtained for analysis of the blood alcohol level.

If drowsy, the patient should be allowed to sleep off the state of alcoholic intoxication. During this time, maintenance of a patent airway and observation for symptoms of CNS depression are essential. The patient should be undressed and kept warm with blankets. On the other hand, if the patient is noisy or belligerent, sedation may be necessary. If sedation is used, the

TABLE 60-1 Emergency Management of Patients with Drug Overdose

Drug	Clinical Manifestations	Therapeutic Management
Cocaine		
Routes may include: • Intranasally ("snorting")—inhaled into nostrils through straws • By smoking ("freebasing")—cocaine hydrochloride dissolved in ether to yield a pure cocaine alkaloid base ("crack," "rocks"); smoking in a small pipe delivers large quantities of cocaine to lungs. • IV • Polysubstance (cocaine and heroin)	Cocaine is a CNS stimulant that can cause: • Increased heart rate and blood pressure • Hyperpyrexia • Seizures • Sluggish, dilated pupillary response • Muscle rigidity • Increased energy, agitation, aggression • Ventricular dysrhythmias • Intense euphoria, then anxiety, sadness, insomnia, and sexual indifference • Cocaine hallucinations with delusions • Psychosis with extreme paranoia and ideas of persecution • Hypervigilance Chronic psychotic symptoms may persist. Overall psychotic symptoms are short-lived compared to methamphetamines	1. Maintain airway and provide respiratory support. 2. Control seizures. 3. Monitor cardiovascular effects; have antiarrhythmic drugs and defibrillator available. 4. Treat for hyperthermia. 5. If cocaine was ingested, evacuate stomach contents and use activated charcoal to treat. Whole bowel irrigation may be necessary to treat body packers ("mules"). 6. Refer for psychiatric evaluation and treatment in an inpatient unit that eliminates access to the drug. Include drug rehabilitation counseling.
Opioids		
Heroin Opium or paregoric Morphine, codeine, semisynthetic derivatives: oxycodone (OxyContin), methadone, meperidine (Demerol), tramadol (Ultram), fentanyl (Sublimaze)	Acute intoxication (overdose) can result in: • Pinpoint pupils (may be dilated with severe hypoxia) • Decreased blood pressure • Marked respiratory depression/arrest • Pulmonary edema • Stupor → coma • Seizures Fresh needle marks along course of any superficial vein Skin abscesses (from "popping")	1. Support respiratory and cardiovascular functions. 2. Establish IV lines; obtain blood for chemical and toxicologic analysis. Patient may be given bolus of glucose to eliminate possibility of hypoglycemia. 3. Administer narcotic antagonist (naloxone hydrochloride IV, IM [Narcan]) as prescribed to reverse severe respiratory depression and coma. 4. Continue to monitor level of responsiveness and respirations, pulse, and blood pressure. Duration of action of naloxone hydrochloride is shorter than that of heroin; repeated dosages may be necessary. 5. Send urine for analysis; opioids can be detected in urine. 6. Obtain an ECG. 7. Do not leave patient unattended; he or she may lapse back into coma rapidly. Clinical status may change from minute to minute. Hemodialysis may be indicated for severe drug intoxication. Activated charcoal may be considered if opioids were taken orally and if the patient is alert. 8. Monitor for pulmonary edema, which is frequently seen in patients who abuse/overdose on narcotics. 9. Refer patient for psychiatric and drug rehabilitation evaluation before discharge.
Barbiturates		
Pentobarbital (Nembutal), secobarbital (Seconal), amobarbital (Amytal), gamma-hydroxybutyrate (GHB, "liquid Ecstasy")	*Acute intoxication (may mimic alcohol intoxication):* • Respiratory depression • Flushed face • Decreased pulse rate; decreased blood pressure • Increasing nystagmus (to vertical and horizontal gaze) • Sluggish pupils • Lack of convergence of eyes • Depressed deep tendon reflexes • Decreasing mental alertness • Difficulty in speaking • Poor motor coordination and flaccid muscles • Coma, death	1. Maintain airway and provide respiratory support. 2. Endotracheal intubation or tracheostomy is considered if there is any doubt about the adequacy of airway exchange. a. Check airway frequently. b. Perform suctioning as necessary. 3. Support cardiovascular and respiratory functions; most deaths result from respiratory depression or shock. 4. Start infusion through large-gauge needle or IV catheter to support blood pressure; coma and dehydration result in hypotension and respond to infusion of IV fluids with elevation of blood pressure. 5. Evacuate stomach contents or lavage if within 1 hour of ingestion to prevent absorption; repeated doses of activated charcoal may be given. 6. Assist with hemodialysis for patient with severe overdose.

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	GHB: • Sexual disinhibition • Amnesia, myoclonus, agitation • Overdoses when mixed with alcohol	7. Maintain neurologic and vital sign flow sheet. 8. Patient awakening from overdose may demonstrate combative behavior. 9. Refer for psychiatric and drug rehabilitation consultation to evaluate suicide potential and drug abuse.
Inhalants		
Amyl nitrate Freon Propane Trichloroethylene Gasoline Perchloroethylene Toluene (metallic paint spray) Helium Canned air Hand sanitizer *Routes may include:* • Sniffing/snorting—direct inhalation of fumes • "Bagging"—sniff from a bag • "Huffing"—sniff from a rag/cloth • "Dusting"—direct spray into the nostrils	Effects mimic those of alcohol, with dizziness and imbalance: • Euphoria, headache, disinhibition, altered level of consciousness to coma • Renal, hepatic, and cardiac toxicity • Aplastic anemia • Fetal growth retardation • Respiratory depression, arrest from CNS depression • Vasodilation • Nosebleeding • Vertical and horizontal nystagmus • Lack of convergence of eyes • Sluggish pupils • Temperature fluctuations • Circumoral red spots/rash • Air embolus	1. Provide airway support, ventilation, and oxygen. 2. Treat cardiac dysrhythmias and hypotension. 3. Provide advanced cardiac life support as needed. 4. Monitor for profound hypotension when amyl nitrate is combined with MDMA and sildenafil or with anesthetic agents. 5. Monitor for hypertension when volatile solvents used.
Amphetamine-Type Drugs (pep pills, "uppers," "speed," "crystal meth")		
Amphetamine (Benzedrine) Dextroamphetamine (Dexedrine) Methamphetamine (Desoxyn, "speed") 3,4-methylenedioxymethamphetamine (MDMA) ("Ecstasy," "Adam")[a] 3,4-methylenedioxy-*N*-ethylamphetamine (MDEA) ("Eve") 3,4-methylenedioxyamphetamine (MDA); methylphenidate (Ritalin) "ice," "rocks," "crystal meth" 3,4-methylenedioxypyrovalerone (MDPV) or 4-methylmethcathinone (mephedrone); "Bath salts" (synthetic stimulant)	• Nausea, vomiting, anorexia • Palpitations, tachycardia • Increased blood pressure • Tachypnea, anxiety • Nervousness • Diaphoresis, mydriasis • Repetitive or stereotyped behavior • Irritability, insomnia, agitation • Visual misperceptions, auditory hallucinations • Fearfulness, anxiety, depression, hostility, paranoia • Hyperactivity, rapid speech, euphoria, hyperalertness • Decreased inhibition • Seizures, coma, hyperthermia • Cardiovascular collapse • Rhabdomyolysis • MDMA is both a hallucinogenic and stimulant. • MDPV and mephedrone effects last >24 hours.	1. Provide airway support, ventilation, cardiac monitoring; insert IV line. 2. Use GI evacuation in cases of oral overdose; activated charcoal, gastric lavage if within 1 hour of ingestion. 3. Keep in calm, cool, quiet environment; elevated temperature potentiates amphetamine toxicity. Maintain normothermia, cooling the patient as necessary. 4. Administer small doses of diazepam (Valium) (IV) or haloperidol (Haldol) as prescribed for CNS and muscular hyperactivity. 5. Administer appropriate pharmacologic therapy as prescribed for severe hypertension and ventricular dysrhythmias. 6. Treat seizures with benzodiazepines (e.g., diazepam) as prescribed. 7. Treat sympathetic stimulation with beta-blocker agents as prescribed. 8. Try to communicate with patient if delusions or hallucinations are present. 9. Place in a protective environment (preferably psychiatric security room with video monitoring) to observe for suicide attempt. 10. Refer for psychiatric and drug rehabilitation evaluation.
Hallucinogens or Psychedelic-Type Drugs		
Lysergic acid diethylamide (LSD) Phencyclidine HCl (PCP, "angel dust") Mescaline, psilocybin Cannabinoids (marijuana) Ketamine ("special K") Synthetic cannabinoids ("spice," "incense," "K2")	• Nystagmus • Pupil dilation • *Psychedelics* a. Sluggish pupillary response b. Increased pulse and temperature c. Muscle rigidity	1. Evaluate and maintain patient's circulation, airway, and breathing. 2. Determine by urine or serum drug screen whether the patient has ingested hallucinogenic drug or has a toxic psychosis.

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Butane honey oil (BHo)—"dabs," "shatter"	• Mild hypertension • Marked confusion bordering on panic • Incoherence, hyperactivity • Withdrawn • Combative behavior; delirium, mania, self-injury (lasts 6–12 hours) • Hallucinations, body image distortion • Hypertension, hyperthermia, acute kidney injury • Flashback—recurrence of LSD-like state without having taken the drug; may occur weeks or months after drug was taken • Ketamine—"out-of-body" experience; increased aggressiveness • Synthetic cannabinoids—euphoria, increased sensory experience, relaxation • Manufacturing can result in burns	3. Try to communicate with and reassure the patient. a. "Talking down" involves understanding the process through which the patient is proceeding and helping the patient overcome fears while establishing contact with reality. b. Remind the patient that fear is common with this problem. c. Reassure the patient that he is not losing his mind but is experiencing the effect of drugs and that this will wear off. d. Instruct the patient to keep the eyes open; this reduces the intensity of reaction. e. Reduce sensory stimuli by minimizing noise, lights, movement, tactile stimulation. 4. Sedate the patient as prescribed if hyperactivity cannot be controlled; diazepam or a barbiturate may be prescribed. 5. Search for evidence of trauma; patients who use hallucinogens have a tendency to "act out" their hallucinations. 6. Manage seizures with benzodiazepines (e.g., diazepam) as necessary. 7. Observe patient closely; patient's behavior may become hazardous. Have safety officers stationed near the patient's room. 8. Monitor for hypertensive crisis if patient has prolonged psychosis due to drug ingestion. 9. Place patient in a protected environment under proper medical supervision to prevent self-inflicted bodily harm. **Management for Phencyclidine Abuse** 1. Place patient in a calm, supportive environment to minimize stimuli; protect from self-injury. 2. Avoid talking down. 3. Do not leave patient unobserved. Treat symptoms as they occur. a. Drug effects are unpredictable and prolonged. b. Symptoms are likely to exacerbate; patient becomes out of control. 4. Refer all patients in this category for psychiatric and drug evaluation/rehabilitation.
Drugs Producing Sedation, Intoxication, or Psychological and Physical Dependence (nonbarbiturate sedatives)		
Diazepam (Valium) Chlordiazepoxide (Librium) Oxazepam (Serax) Lorazepam (Ativan) Midazolam (Versed) Flunitrazepam (Rohypnol, "roofies," "date rape drug")[a]	Seizures, coma, circulatory collapse, death *Acute intoxication:* • Respiratory depression • Decreasing mental alertness • Confusion • Slurred speech, decreased blood pressure • Ataxia • Pulmonary edema • Coma, death **Flunitrazepam:** • Disinhibition with anterograde amnesia • Weakness and unsteadiness with impaired judgment • Powerlessness	1. Endotracheal tube is inserted as a precaution; use assisted ventilation to stabilize and correct respiratory depression. Observe for sudden apnea and laryngeal spasm. 2. Assess for hypotension. a. Insert indwelling urinary catheter for patient who is comatose; decreased urinary volume is an index of reduced renal flow associated with reduced intravascular volume or vascular collapse. b. Start volume expansion with saline or dextrose as prescribed. 3. Evacuate stomach contents; lavage (if within 1 hour of ingestion); activated charcoal. 4. Start ECG monitoring. Observe for dysrhythmias. 5. Administer flumazenil (Romazicon), a benzodiazepine antagonist (reversal agent). 6. Refer patient for psychiatric evaluation (potential suicide intent).

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Salicylate Poisoning		
Aspirin (present in compound analgesic tablets) • Toxic levels (150–200 mg/kg body weight) • Chronic toxicity (occurs in older adults due to decreased kidney function) • Long-term intoxication (>100 mg/kg/day for more than 2 days)	• Restlessness • Tinnitus, deafness • Blurring of vision • Hyperpnea • Hyperpyrexia • Sweating • Epigastric pain, vomiting • Dehydration • Respiratory alkalosis and metabolic acidosis • Disorientation, coma • Cardiovascular collapse • Coagulopathy	1. Treat respiratory depression. 2. Induce gastric emptying by lavage (if within 1 hour after ingestion). 3. Give activated charcoal to adsorb aspirin. 4. Support patient with IV infusions as prescribed to establish hydration and correct electrolyte imbalances, including administration of sodium bicarbonate. 5. Enhance elimination of salicylates as directed by forced diuresis, alkalinization of urine, peritoneal dialysis, or hemodialysis, according to severity of intoxication. 6. Monitor serum salicylate level for efficacy of treatment. 7. Administer specific prescribed pharmacologic agent for bleeding and other problems. 8. Recognize that concretions formed in the gut may result in prolonged exposure as they are digested. 9. Refer patient for psychiatric evaluation (potential suicide intent). 10. Monitor thromboelastography for platelet function.
Acetaminophen/paracetamol (present in prescription and nonprescription analgesics, antipyretics, and cold remedies)	Lethargy to encephalopathy and death GI upset, diaphoresis Right upper quadrant pain Abnormal liver function tests, prolonged prothrombin time, increased bilirubin, disseminated intravascular coagulation Hepatomegaly leading to liver failure Metabolic acidosis Hypoglycemia Stage I—within 24 hours; GI irritation, possible metabolic acidosis and coma if severe ingestion Stage II—24–48 hours; monitor liver and coagulation studies. Stage III—after 48 hours; hepatic encephalopathy/jaundice, vomiting, right upper quadrant pain, coagulopathy, hypoglycemia, acute kidney injury	1. Maintain airway. 2. Obtain acetaminophen / paracetamol level. Levels ≥140 mg/kg are toxic. 3. Laboratory studies—liver function tests, prothrombin time/partial thromboplastin time, complete blood count, blood urea nitrogen, creatinine. 4. Lavage (if within 1 hour after ingestion); activated charcoal. 5. Prepare for possible hemodialysis, which clears acetaminophen / paracetamol but does not halt liver damage. 6. Administer N-acetylcysteine (Mucomyst) as soon as possible. N-acetylcysteine replenishes essential liver enzymes and requires a total of 18 doses every 4 hours. Charcoal absorbs N-acetylcysteine; do not administer together. Repeat N-acetylcysteine dose if patient vomits. 7. Refer patient for psychiatric evaluation (potential suicide intent).
Tricyclic Antidepressants		
Amitriptyline (Elavil) Doxepin (Sinequan) Nortriptyline (Aventyl) Imipramine (Tofranil)	Dysrhythmia: ventricular fibrillation/tachycardia, sinus tachycardia Hypotension Pulmonary edema, hypoxemia, acidosis Confusion, agitation, coma Visual hallucinations Clonus, tremors, hyperactive reflexes, nystagmus, myoclonic jerking Seizures Blurred vision, flushing, hyperthermia	1. Provide airway support, ventilation, cardiac monitoring; insert IV line with normal saline solution. 2. If within 1–2 hours after overdose, insert a nasogastric tube and instill activated charcoal every 4 hours × 3. 3. Administer a sodium bicarbonate drip to decrease dysrhythmias; the alkaline environment increases the protein binding of the metabolite. Synchronized cardioversion may be indicated with some dysrhythmias refractory to sodium bicarbonate. Torsades de pointes should be treated with IV magnesium sulfate. 4. Administer vasopressors. 5. Manage seizure activity with benzodiazepines (e.g., diazepam) as necessary. 6. Refer patient for psychiatric evaluation for potential suicide intent and evaluation of medication regimen for effectiveness.

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Selective Serotonin Reuptake Inhibitors and Other Antidepressants		
Trazodone (Desyrel) Fluoxetine (Prozac) Paroxetine (Paxil) Sertraline (Zoloft) Venlafaxine (Effexor) Escitalopram (Lexapro) Bupropion (Wellbutrin)	Decreased level of consciousness, confusion Respiratory depression Increased heart rate Serotonin syndrome may occur if the SSRI was taken in conjunction with dextromethorphan or meperidine Agitation, seizures Hyperthermia, diaphoresis Hypertension, headache, shivering, "goose flesh," cardiac dysrhythmias, loss of consciousness	1. Administer activated charcoal with possibly whole bowel irrigation if a sustained-release medication was taken. 2. Use seizure precautions and administer benzodiazepines (e.g., diazepam) as prescribed.
Anabolic Steroids "roids," "juice," methandrostenolone, stanozolol, nandrolone Synthetic testosterone	Increase in LDL, decrease in HDL Alter carbohydrate metabolism Hyponatremia, hypokalemia Hypocalcemia/osteoporosis Mood swings/violent behaviors Invincibility, depression, potential for suicide attempts Memory loss, cognitive disabilities Immunosuppression Used to bulk up muscles, so skeletal muscle hypertrophy is a common manifestation.	1. Provide supportive therapy appropriate to patient's emotional manifestations. 2. Protect the patient from self-harm/harming others. 3. Encourage the patient to stop use; refer patient for psychiatric evaluation.

→, precedes; CNS, central nervous system; ECG, electrocardiogram; GI, gastrointestinal; HDL, high-density lipoprotein; IM, intramuscular; IV, intravenous; LDL, low-density lipoprotein; NAC, N-acetylcysteine; SSRI, selective serotonin reuptake inhibitor.

[a]Polydrug use at "rave clubs" frequently involves MDMA, alcohol, amphetamines, LSD, and sometimes dextromethorphan. Terms such as "Ecstasy" may refer to flunitrazepam (Rohypnol), GHB, ephedrine, and/or caffeine, in addition to MDMA.

Adapted from Emergency Nurses Association. (2013). Sheehy's manual of emergency care (7th ed.). St. Louis, MO: Mosby; National Institute on Drug Abuse (2015a). Drug facts. Retrieved on 2/20/2017 at: www.drugabuse.gov/publications/drugfacts/; Tintinalli, J. E., Stapczyski, J. S., Ma, O. J, et al., (2016). Tintinalli's emergency medicine manual (8th ed.). New York: McGraw-Hill Medical.

patient should be monitored carefully for hypotension and decreased LOC.

In addition, the patient is examined for alcohol withdrawal delirium and for injuries and organic disease (such as head injury, seizures, pulmonary infections, hypoglycemia, and nutritional deficiencies) that may be masked by alcoholic intoxication. People with alcoholism suffer more injuries than the general population. Acute alcohol intoxication is the cause of trauma for many patients without alcoholism as well. Pulmonary infections are also more common in patients with alcoholism, resulting from respiratory depression, an impaired defense system, and a tendency toward aspiration of gastric contents. The patient may show little increase in temperature or WBC count. The patient may be hospitalized or admitted to a detoxification center in an effort to examine problems underlying the substance abuse (ENA, 2013).

Alcohol Withdrawal Syndrome/ Delirium Tremens

Alcohol withdrawal syndrome is an acute toxic state that occurs as a result of sudden cessation of alcohol intake after a bout of heavy drinking or, more typically, after prolonged intake of alcohol. Severity of symptoms depends on how much alcohol was ingested and for how long. Delirium tremens may be precipitated by acute injury or infection (pneumonia, pancreatitis, hepatitis) and is the most severe form of alcohol withdrawal syndrome (ENA, 2013). Delirium tremens is a life-threatening condition and carries a high mortality rate if untreated (ENA, 2013).

Patients with alcohol withdrawal syndrome show signs of anxiety, uncontrollable fear, tremor, irritability, agitation, insomnia, and incontinence. They are talkative and preoccupied and experience visual, tactile, olfactory, and auditory hallucinations that often are terrifying. Autonomic overactivity occurs and is evidenced by tachycardia, dilated pupils, and profuse perspiration. Usually, all vital signs are elevated in the alcoholic toxic state.

The goals of management are to give adequate sedation and support to allow the patient to rest and recover without danger of injury or peripheral vascular collapse. A physical examination is performed to identify pre-existing or contributing illnesses or injuries (e.g., head injury, pneumonia). A drug history is obtained to elicit information that may facilitate adjustment of any sedative requirements. Baseline blood pressure is determined, because the patient's subsequent treatment may depend on blood pressure changes.

Usually, the patient is sedated as directed with a sufficient dosage of benzodiazepines to establish and maintain sedation, which reduces agitation, prevents exhaustion, prevents seizures,

and promotes sleep. The patient should be calm, able to respond, and able to maintain an airway safely on their own. A variety of medications and combinations of medications are used (e.g., chlordiazepoxide [Librium], lorazepam [Ativan], and clonidine [Catapres]). Haloperidol (Haldol), esmolol (Brevibloc), or midazolam (Versed) may be given for severe acute alcohol withdrawal syndrome. Dosages are adjusted according to the patient's symptoms (agitation, anxiety) and blood pressure response (ENA, 2013).

The patient is placed in a calm, nonstressful environment (usually a private room) and observed closely. The room remains lighted to minimize the potential for illusions (visual misrepresentations) and hallucinations. Homicidal or suicidal responses may result from hallucinations. Closet and bathroom doors are closed to eliminate shadows. Someone is designated to stay with the patient as much as possible. The presence of another person has a reassuring and calming effect, which helps the patient maintain contact with reality. To orient the patient to reality, any illusions are explained.

Nursing Alert: Restraints are used as prescribed, if necessary, if the patient is aggressive or violent, but only when other alternatives have been unsuccessful. The least restrictive device that will prevent the patient from injuring him- or herself or others is used. Caution is taken to ensure that restraints are applied properly and that they are not impairing circulation to any part of the body or interfering with respirations. Restraints should be used in tandem with verbal intervention to calm the patient and promote adherence. Restraints must be released according to protocol. Physical observation (e.g., skin integrity, circulatory status, respiratory status) is ongoing, and the patient's response is documented.

Fluid losses may result from gastrointestinal losses (vomiting), profuse perspiration, and hyperventilation. In addition, the patient may be dehydrated as a result of alcohol's effect of decreasing antidiuretic hormone. The oral or IV route is used to restore fluid and electrolyte balance.

Temperature, pulse, respiration, and blood pressure are recorded frequently (every 30 minutes in severe forms of delirium) to monitor for peripheral circulatory collapse or hyperthermia (the two most serious complications).

Frequently seen complications include infections (e.g., pneumonia), trauma, hepatic failure, hypoglycemia, and cardiovascular problems. Hypoglycemia may accompany alcohol withdrawal, because alcohol depletes liver glycogen stores and impairs gluconeogenesis; many patients with alcoholism also are malnourished. Parenteral dextrose may be prescribed if the liver glycogen level is depleted. Orange juice, sports drinks, or other sources of carbohydrates are given to stabilize the blood glucose level and counteract tremulousness. Supplemental vitamin therapy and a high-protein diet are provided as prescribed to counteract nutritional deficits. The patient should be referred to an alcoholic treatment center for follow-up care and rehabilitation.

VIOLENCE, ABUSE, AND NEGLECT

Family Violence, Abuse, and Neglect

EDs are often the first place where victims of family violence, abuse, or neglect go to seek help.

Clinical Manifestations

When people who have been abused seek treatment, they may present with physical injuries or health problems such as anxiety, insomnia, or gastrointestinal symptoms related to stress. The possibility of abuse should be investigated whenever a person presents with multiple injuries that are in various stages of healing, when injuries are unexplained, and when the explanation does not fit the physical picture. The possibility of neglect should be investigated whenever a person who is dependent shows evidence of inattention to hygiene, to nutrition, or to know medical needs (e.g., unfilled medication prescriptions, missed appointments with health care providers). In the ED, the most common physical injuries seen are unexplained bruises, lacerations, abrasions, head injuries, or fractures. The most common clinical manifestations of neglect are malnutrition and dehydration.

Assessment and Diagnostic Findings

Nurses in EDs are in an ideal position to provide early detection and interventions for victims of Intimate Partner Violence (IPV). This requires an acute awareness of the signs of possible abuse, maltreatment, and neglect. Nurses must be skilled in interviewing techniques that are likely to elicit accurate information. A careful history is crucial in the screening process. Asking questions in private—away from others—may be helpful in eliciting information about abuse, maltreatment, and neglect. Nurses need to be aware that women may withhold directly answering questions regarding IPV in fear of retaliation, loss of children, and retribution against the children (Amerson, Whittington, & Duggan, 2014).

Whenever evidence leads the nurse to suspect abuse or neglect, an evaluation with careful documentation of descriptions of events and drawings or photographs of injuries is important, because the medical record may be used as part of a legal proceeding. Assessment of the patient's general appearance and interactions with significant others, an examination of the entire surface area of the body, and a mental status examination are crucial.

Management

The aims of IPV screening include earlier identification of patients who have been abused and prevention of continued abusive events, including homicide (Day, Fox, Majercik, et al., 2015). Whenever abuse, maltreatment, or neglect is suspected, the health care provider's main concern should be the safety and welfare of the patient. Treatment focuses on the consequences of the abuse, violence, or neglect and on prevention of further injury. Protocols of most EDs require that a multidisciplinary approach be used. Nurses, physicians, social workers, and community agencies work collaboratively to develop and implement a plan for meeting the patient's needs.

If the patient is in immediate danger, he or she should be separated from the person who is abusive or neglectful whenever possible. Referral to a shelter may be the most appropriate action, but many shelters are inaccessible to people with mobility limitations.

When abuse or neglect is the result of stress experienced by a caregiver who is no longer able to cope with the burden of caring for an older adult or a person with chronic disease or a disability, respite services may be necessary. Support groups may be helpful to these caregivers. When mental illness of the person who is abusive or neglectful is responsible for the situation, alternative living arrangements may be required.

Nurses must be mindful that competent adults are free to accept or refuse the help that is offered to them. Some patients insist on remaining in the home environment where the abuse or neglect is occurring. The wishes of patients who are competent and not cognitively impaired should be respected. However, all possible alternatives, available resources, and safety plans should be explored with the patient.

Health care workers are expected to report *suspected* child abuse or abuse of older adults to a local police station or Child Protective Services. All that is required for reporting is the suspicion of abuse; the health care worker is not required to prove abuse or neglect. Likewise, health care workers who report suspected abuse are immune from civil or criminal liability if the report is made in good faith. Subsequent home visits resulting from the report of suspected abuse are a part of gathering information about the patient in the home environment.

Sexual Assault

The definition of *rape* is forced sexual acts, especially if these acts involve vaginal or anal penetration. Attempted rape may include verbal threats of rape (ENA, 2013). Perpetrators and victims may be either male or female.

The manner in which the patient is received and treated in the ED is important to their future psychological well-being. Crisis intervention should begin when the patient enters the health care facility. The patient should be seen immediately. Most hospitals have a written protocol that addresses the patient's physical and emotional needs as well as collection of forensic evidence.

Assessment and Diagnostic Findings

The patient's reaction to rape has been termed *rape trauma syndrome* and is seen as an acute stress reaction to a life-threatening situation. The nurse performing the assessment is aware that the patient may go through several phases of psychological reactions, which have been described as follows:

- An acute disorganization phase, which may manifest as an expressed state in which shock, disbelief, fear, guilt, humiliation, anger, and other such emotions are encountered or as a controlled state in which feelings are masked or hidden and the victim appears composed
- A phase of denial and unwillingness to talk about the incident, followed by a phase of heightened anxiety, fear, flashbacks, sleep disturbances, hyperalertness, and psychosomatic reactions that is consistent with PTSD (see later discussion)
- A phase of reorganization, in which the incident is put into perspective. Some victims never fully recover and go on to develop chronic stress disorders and phobias.

Management

The goals of management are to provide support, to reduce the patient's emotional trauma, and to gather available evidence for possible legal proceedings. All of the interventions are aimed at encouraging the patient to gain a sense of control over their life.

Throughout the patient's stay in the ED, the patient's privacy and sensitivity must be respected. The patient may exhibit a wide range of emotional reactions, such as hysteria, stoicism, or feelings of being overwhelmed. Support and caring are crucial. The patient should be reassured. The patient should never be left alone.

Physical Examination

A written, witnessed informed consent must be obtained from the patient (or parent or guardian if the patient is a minor) for examination, for taking of photographs, and for release of findings to police. A history is obtained only if the patient has not already talked to a police officer, social worker, or crisis intervention worker. The patient should not be asked to repeat the history. Any history of the event that is obtained should be recorded in the patient's own words. The patient is asked whether he or she has bathed, douched, brushed his or her teeth, changed clothes, urinated, or defecated since the attack, because these actions may alter interpretation of subsequent findings. The time of admission, time of examination, date and time of the alleged rape, and the patient's emotional state and general appearance (including any evidence of trauma, such as discoloration, bruises, lacerations, secretions, or torn and bloody clothing) are documented. If the patient has no recollection of the event, drugs that induce retrograde amnesia may have been involved, such as alcohol, ketamine, gamma-hydroxybutyrate, benzodiazepines, or flunitrazepam (Rohypnol). Urine drug test must be completed within 96 hours of the event to capture the presence of these drugs. Emesis can also be collected for testing (ENA, 2013).

For the physical examination, the patient is helped to undress and is draped properly. Each item of clothing is placed in a separate paper bag. As noted earlier, plastic bags are not used in order to avoid possible destruction of evidence from mold or mildew formation. The bags are labeled and given to appropriate law enforcement authorities.

The patient is examined (from head to toe) for injuries, especially injuries to the head, neck, breasts, thighs, back, and buttocks. Body diagrams and photographs aid in documenting the evidence of trauma. The physical examination focuses on the following:

- External evidence of trauma (bruises, contusions, lacerations, stab wounds)
- Dried semen stains (appearing as crusted, flaking areas) on the patient's body or clothes
- Broken fingernails and body tissue and foreign materials under nails (if found, samples are taken)
- Oral examination, including a specimen of saliva and cultures of gum and tooth areas

Pelvic and rectal examinations are also performed. The perineum and other areas are examined with a Wood lamp or other filtered ultraviolet light. Areas that appear fluorescent may indicate semen stains. The color and consistency of any discharge present is noted. A water-moistened, rather than lubricated, vaginal speculum is used for the examination. Lubricant contains chemicals that may interfere with later forensic testing of specimens and acid phosphatase determinations. The rectum is examined for signs of trauma, blood, and semen. During the examination, the patient should be advised of the nature and necessity of each procedure and given the rationale for each (ENA, 2013).

Specimen Collection

During the physical examination, numerous laboratory specimens may be collected, including the following:

- Vaginal aspirate, examined for presence or absence of motile and nonmotile sperm.
- Secretions (obtained with a sterile swab) from the vaginal pool for acid phosphatase, blood group antigen of semen, and precipitin test against human sperm and blood.

- Separate smears from the oral, vaginal, and anal areas.
- Culture of body orifices for gonorrhea.
- Blood serum for syphilis and HIV testing and deoxyribonucleic acid (DNA) analysis. A sample of serum for syphilis may be frozen and saved for future testing.
- Pregnancy test if there is a possibility that the female patient may be pregnant.
- Any foreign material (leaves, grass, dirt), which is placed in a clean envelope.
- Pubic hair samples obtained by combing or trimming. Several pubic hairs with follicles are placed in separate containers and identified as the patient's hair.

To preserve the chain of evidence, each specimen is labeled with the name of the patient, the date and time of collection, the body area from which the specimen was obtained, and the names of personnel collecting specimens. The specimens are then given to a designated person (e.g., crime laboratory technician), and an itemized receipt is obtained (ENA, 2013).

Treating Potential Consequences of Rape

After the initial physical examination is completed and specimens have been obtained, any associated injuries are treated as indicated. The patient is given the option of prophylaxis against sexually transmitted infections (STIs) (also referred to as sexually transmitted disease [STDs]). Ceftriaxone (Rocephin), given intramuscularly with 1% lidocaine (Xylocaine), may be prescribed as prophylaxis for gonorrhea. In addition, a single oral dose of metronidazole (Flagyl) and either a single oral dose of azithromycin (Zithromax) or a 7-day oral regimen of doxycycline may be prescribed as prophylaxis for syphilis and chlamydia (ENA, 2013); (Solheim, 2016).

Antipregnancy measures may be considered if the patient is a female of childbearing age. A postcoital contraceptive medication, such as an oral contraceptive medication that contains levonorgestrel and ethinyl estradiol (Alesse, Seasonique), may be prescribed after a pregnancy test. To promote effectiveness, the contraceptive medication should be given within 12 to 24 hours and no later than 72 hours after intercourse. The 21-day package is prescribed so that the patient does not mistakenly take the inert tablets included in the 28-day package. An antiemetic agent may be given as prescribed to decrease discomfort from side effects. A cleansing douche, mouthwash, and fresh clothing are usually offered.

Follow-Up Care

The patient is informed of counseling services to prevent long-term psychological effects. Counseling services should be made available to both the patient and the family.

The patient is encouraged to return to their previous level of functioning as soon as possible. When leaving the ED, the patient should be accompanied by a family member or friend.

PSYCHIATRIC EMERGENCIES

A psychiatric emergency is an urgent, serious disturbance of behavior, affect, or thought that makes the patient unable to cope with life situations and interpersonal relationships. A patient presenting with a psychiatric emergency may display overactive or violent, underactive or depressed, or suicidal behaviors.

The most important concern of the ED personnel is determining whether the patient is at risk for injuring self or others. The aim is to try to maintain the patient's self-esteem (and life, if necessary) while providing care. Determining whether the patient is under psychiatric care is important so that contact can be made with the therapist or physician who works with the patient.

Patients who are Overactive

Patients who display disturbed, uncooperative, and paranoid behavior and those who feel anxious and panicky may be prone to assaultive and destructive impulses and abnormal social behavior. Intense nervousness, depression, and crying are evident in some patients. Disturbed and noisy behavior may be exacerbated or compounded by alcohol or drug intoxication.

A reliable source for obtaining an accurate history is needed to identify events leading to the crisis. Past mental illness, hospitalizations, injuries, serious illnesses, the use of alcohol or drugs, crises in interpersonal relationships, or intrapsychic conflicts are explored. Because abnormal thoughts and behavior may be manifestations of an underlying physical disorder, such as hypoglycemia, drug or alcohol toxicity, a stroke, a seizure disorder, or head injury, a physical assessment is also performed.

The immediate goal is to gain control of the situation. If the patient is potentially violent, security or police should be nearby. Restraints are used as a *last* resort and only as prescribed. Approaching the patient with a composed, confident, and firm manner is therapeutic and has a calming effect. Helpful interventions include the following:

- Introduce yourself by name.
- Tell the patient, "I am here to help you."
- Repeat the patient's name from time to time.
- Speak in one-thought sentences, and be consistent.
- Give the patient space and time to slow down.
- Show interest in, listen to, and encourage the patient to talk about personal thoughts and feelings.
- Offer appropriate and honest explanations.

A psychotropic agent (e.g., one that exerts an effect on the mind) may be prescribed for emergency management of functional psychosis. However, a patient with a personality disorder should not be treated with psychotropic medications, and psychotropic medications should not be used if the patient's behavior results from the use of hallucinogens (e.g., lysergic acid diethylamide [LSD]).

Agents such as chlorpromazine and haloperidol act specifically against psychotic symptoms of thought fragmentation and perceptual and behavioral aberrations. The initial dose depends on the patient's body weight and the severity of the symptoms. After administration of the initial dose, the patient is observed closely to determine the degree of change in psychotic behavior. Subsequent doses depend on the patient's response. Typically, after stabilization, the patient is transferred to an inpatient psychiatric unit, or psychiatric outpatient treatment is arranged.

Posttraumatic Stress Disorder

PTSD is the development of characteristic symptoms after a psychologically stressful event that is considered outside the range of normal human experience (e.g., rape, combat, motor vehicle crash, natural catastrophe, terrorist attack). Symptoms of this disorder include intrusive thoughts and dreams, phobic avoidance reaction (avoidance of activities that arouse recollection of the traumatic event), heightened vigilance,

exaggerated startle reaction, generalized anxiety, and societal withdrawal. PTSD may be acute, chronic, or delayed. PTSD often presents as multiple readmissions to the ED for minor or recurring complaints without evidence of injury.

Patients who are Underactive or Depressed

In the ED, depression may be seen as the main condition bringing the patient to the health care facility, or it may be masked by anxiety and somatic complaints. The person who is depressed has a mood disturbance.

Any patient who is depressed may be at risk for suicide. Attempts are made to find out whether the patient has thought about or attempted suicide. Questions such as "Have you ever thought about taking your own life?" may be helpful. In general, the patient is relieved to have an opportunity to discuss personal feelings. If the patient is seriously depressed, relatives should be notified. The patient should never be left alone, because suicide is usually committed in solitude.

Patients who are Suicidal

Attempted suicide is an act that stems from depression (e.g., loss of a loved one, loss of body integrity or status, poor self-image) and can be viewed as a cry for help and intervention. Males are at greater risk of successfully committing suicide than females, who attempt suicide more often (ENA, 2013). In 2016, the suicide rate among Indians was 15.7/100,000. Sri Lanka had the highest suicide-related mortality rate of 35.3/100,000. Pakistan and Bangladesh had lower suicide rate with 2.1 and 5.5 per 100,000 respectively. The suicidal death rate in Maldives was 11.7/100,000 while in Bhutan and in Nepal it was 6.0 per 100,000 (WHO, 2017).

Others at risk are older adults; young adults; people who are enduring unusual loss or stress; those who are unemployed, divorced, widowed, or living alone; those showing signs of significant depression (e.g., weight loss, sleep disturbances, somatic complaints, suicidal preoccupation); and those with a history of a previous suicide attempt, suicide in the family, or psychiatric illness.

Being aware of people at risk and assessing for specific factors that predispose a person to suicide are key management strategies. Specific signs and symptoms of potential suicide include the following:

- Communication of *suicidal intent,* such as preoccupation with death or speaking of someone else's suicide (e.g., "I'm tired of living. I've put my affairs in order. I'm better off dead. I'm a burden to my family.")
- History of a previous suicide attempt, with risk being much greater in these cases
- Family history of suicide
- Loss of a parent at an early age
- Specific plan for suicide
- A means to carry out the plan

Emergency management focuses on treating the consequences of the suicide attempt (e.g., gunshot wound, drug overdose) and preventing further self-injury. A patient who has made a suicidal attempt may do so again. Crisis intervention is used to determine suicidal potential, to discover areas of depression and conflict, to find out about the patient's support system, and to determine whether hospitalization or psychiatric referral is necessary. Depending on the patient's potential for suicide, the patient may be admitted to the intensive care unit, referred for follow-up care, or admitted to the psychiatric unit.

Legal and Ethical Issues in Emergency Nursing

Article 21 of the Constitution of India ensures the right to life and dignity, but there is no specific legal provision for the right for emergency care (Uttamdubey, 2021). During the COVID pandemic, patients who required medical services, O_2 therapy, and ventilator care were denied care due to lack of availability. In certain hospitals, emergency care was denied till patients could produce a COVID-19 negative certificate. India, with a vast population of 135 crores, has only 0.7 beds per 1000 people. Acute shortage of critical resources and lack of trained manpower leads to undue delay in provision of timely care to accident victims.

The trauma patients reaching emergency are denied care during golden period and they are subjected to travel far away hospitals for further treatment which puts life of the victims under jeopardy. Based on the litigation filed in supreme court of India, Pramand Katra vs. Union of India, the court directed that the emergency care should not be denied to accident victims. It mandates the duty doctors and other professionals in emergency room/casualty to attend and provide first aid to the victim irrespective of other legal formalities. The bystanders role is equally important for better patient outcome. As per the recent reports, three out of four bystanders at the accident scene do not help the injured victim for fear of police harassment, imprisonment, and legal hurdles (Chauhan, 2022). The recent amendment of the Motor Vehicle Act, 2019, based on the good Samaritan principle allows the bystanders/volunteers to help the accident victims without any legal impingements.

Nurses or Emergency room physician who handle victims of terror, road traffic accident, assault, or attempted suicide need to inform the nearest police station. The particular patient has to be considered as a medicolegal case. In the instances of the death of a patient registered under medicolegal case registry, the deceased victim's body should never be handed over to the family members; rather it has to be handed over to the police for autopsy. In case the victim is transferred or discharged, the same police station officials need to be intimated about the discharge/transfer.

Nurses' record become legal document and may be present to the court. Nurses need to record their observations neatly and legibly. All the evidence, articles, emesis, or discharge, etc., may be preserved for further forensic analysis. In some instances, the dying victim may explain the cause of her impending death to the health care team which may become the dying declaration.

Ethical Issues in Emergency Nursing

Ethics are the philosophical guidelines to guide nurses in decision making when the situation presents with an ethical dilemma. The guiding ethical principles are as follows:

- **Beneficence:** Doing things that help the patient to recover from illness or debility.
- **Nonmaleficence:** Doing no harm.
- **Justice:** Being fair to all in allocation of resources or time for care.
- **Autonomy:** Every individual patient has the right to determine what treatment they need to take or stop taking the treatment. Nurses need to ensure that the ethical principle of autonomy is adhered.
- **Confidentiality:** Keeping the confidential personal information secret. Divulging information only when the situation warrants to those involved in the personal care of the individual.
- **Veracity:** Telling the truth only.

There are many instances where more than one ethical principles lie contrary to each other and create a dilemma. According to the principle of beneficence, every patient needs to be treated and cared for in a timely manner to aid in recovery. During the process of triage some patients may be wrongly placed in low priority and eventually they may transcend to high priority. In a country like India with limited medical resources, a patient may not be provided with the most suitable treatment options all the time due to lack of valued resources.

In some situations, the injured patients or victims of terrorism may be brought to the hospital in unconscious state without any of their legal heir. Major health care decisions like surgery may get delayed or may be taken by the treating physician. In this case, the principle of autonomy and principle of beneficence may be the conflicting values. In case of poisoning, the confidentiality and autonomy is in question. Principle of Justice could not be adhered to at times. For example, the world witnessed the COVID pandemic and there was acute shortage of resources. Principles of Justice had been violated in this scenario

CRITICAL THINKING EXERCISES

1. After falling down the stairs, a 25-year-old woman arrives at the ED by car accompanied by an older male. Various parts of her body have bruises, some of which appear to be in various stages of healing. When asked to step to the waiting room, the male refuses; security is required to remove him from the room so that the patient examination can occur privately. The patient is particularly quiet and does not actively participate in her history or questions regarding her injuries. As the nurse interviewing and assessing this patient, what do you suspect? You also note that the patient jumps at a knock on the door and pulls away from touch. She states her occupation is a waitress. How do you evaluate the patient situation? What is expected of the nurse in terms of reporting the patient situation? What strategies should be used to provide sensitive care for this patient?
2. A 28-year-old male with a gunshot wound arrives to the hospital lobby after being dropped off by an unknown driver who has abandoned him. He is actively bleeding from multiple wounds in his chest and abdomen and is having difficulty breathing and speaking. The security guard in the lobby calls the ED. The patient is brought rapidly to the ED for assessment and disposition. What are the first measures of the primary survey that you will use to assess and stabilize the patient? Will you expect to administer blood products? What do you anticipate in terms of the ED disposition for this patient? What security measures need to be in place to maintain patient, staff, and visitor safety?
3. Two males in their thirties are transported by EMS to the ED after a house-fire. The EMS agency states suspicious evidence was found in the kitchen, which seemed to be the source of the fire. The patients are hesitant to discuss the events prior to the fire. Both suffered multiple full-thickness burns to their upper extremities, face, neck, and chest. EMS personnel expressed concern about contaminants at the scene, which may be on the patients' clothing. What decision must be made regarding decontamination versus immediate burn care? What is the possible source of the contaminants? As with all patients who have experienced trauma, what is the strength of the evidence that dictates first priorities? In addition to the contaminants, to what other chemical were the patients exposed that may result in inadequate ventilation?
4. It is midsummer and you work in an urban ED. The community includes a large low income and older adult population, and many local residents are concerned about the degree of crime in the area. An 80-year-old woman is brought to the ED unresponsive, skin very dry, pale, with low blood pressure, and with slight tachycardia. Her history includes that she takes a beta blocker and a diuretic for hypertension. Her family states that she lives alone without air conditioning. She rarely opens windows or uses a fan in a window due to fear of a break-in. What do you suspect is the primary problem for this patient? What would you expect her core temperature to be? What will be the immediate treatment for this disorder from which she is suffering? What do you expect her ED disposition to be?

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

American College of Surgeons. (2013). Advanced trauma life support (9th ed.). Chicago, IL: Author.

Auerbach, P. S. (2017). Wilderness medicine (7th ed.). St. Louis, MO: Elsevier Mosby.

Emergency Nurses Association. (2013). Sheehy's manual of emergency care (7th ed.). St. Louis, MO: Mosby.

Gilboy, N., Tanabe, P., Travers, D., et al. (2012). Emergency severity index (ESI): A triage tool for emergency department care, version 4. Implementation handbook. Publication No. 12–0014. Rockville, MD: Agency for Healthcare Research and Quality, Publication.

Nayduch, D. (2009). Nurse to nurse trauma care. New York: McGraw-Hill.

Solheim, J. (2016). Emergency nursing: The profession/the pathway/the practice. Indianapolis: Sigma Theta Tau International Honor Society of Nursing.

Tintinalli, J. E., Stapczyski, J. S., Ma, O. J., et al., (2016). Tintinalli's emergency medicine manual (8th ed.). New York: McGraw-Hill Medical.

Walsh, K., & Woten, M. (2016). Oropharyngeal airway: Inserting in adults. In D. Pravikoff (Ed.): Nursing practice and skill. Glendale, CA: CINAHL Information Systems.

Journals and Electronic Documents

American College of Emergency Physicians (ACEP). (2011). Protection from physical violence in the emergency department environment. ACEP Policy Statement. Retrieved on 1/8/2017 at: www.acep.org/policystatements/

American College of Emergency Physicians (ACEP). (2014). Use of patient restraints. ACEP Policy Statement. Retrieved on 1/8/2017 at: www.acep.org/policystatements/

Amerson, R., Whittington, R., & Duggan, L. (2014). Intimate partner violence affecting Latina women and their children. Journal of Emergency Nursing, 40(6), 531–536.

*Avander, K., Heikki, A., Bjersa, K., et al. (2016). Trauma nurses' experience of workplace violence and threats: Short- and long-term consequences in a Swedish setting. Journal of Trauma Nursing, 23(2), 51–57.

Baumann, M. H., Patilla, J. S., Lehner, K. R., et al. (2013). Powerful cocaine-like actions of 3,4-methylenedioxypyrovalerone (MDPV), a principal constituent of psychoactive 'bath salts' products. Neuropsychopharmacology, 38(4), 552–562.

**Blow, O., Magliore, L., Claridge, J. A., et al. (1999). The golden hour and the silver day: Detection and correction of occult hypoperfusion within 24 hours improves outcome from major trauma. Journal of Trauma, 47(5), 964–969.

*Cadogan, M. P., Phillips, L. R., & Ziminski, C. E. (2016). A perfect storm: Care transitions for vulnerable older adults discharged home from the emergency department without a hospital admission. The Gerontologist, 56(2), 326–334.

Causes of Death Statistics, 2010–2013. A joint report of Registrar General of India and the Center for Global Health Research. Retrieved on June 3rd, 2018, at: http://www.cghr.org/wordpress/wp-content/uploads/COD-India-Report-2010-2013-Dec-19-2015.pdf.

Centers for Disease Control and Prevention (CDC). (2013). Emergency department visits by persons aged 65 and over: United States, 2009-2010. NCHS Data Brief 130. Retrieved on 2/16/2017 at: www.cdc.gov/nchs/data/databriefs/db130.htm

Centers for Disease Control and Prevention (CDC). (2014). Unintentional drowning deaths in the United States, 2009-2010. NCHS Data Brief 149. Retrieved on 2/16/2017 at: www.cdc.gov/nchs/data/databriefs/db149.pdf

Chauhan, D. (n.d). Golden hour: The importance of medical care in motor vehicle accidents. Retrieved on 05/23/2022 at: https://www.legalserviceindia.com/legal/article-6206-golden-hour-the-importance-of-emergency-medical-care-in-motor-vehicular-accidents.html

Childs, B. R., Nahm, N. J., Dolenc, A. J., et al. (2015). Obesity is associated with more complications and longer hospital stays after orthopaedic trauma. Journal of Orthopaedic Trauma, 29(11), 504–509.

*Day, S., Fox, J., Majercik, S., et al. (2015). Implementing a domestic violence screening program. Journal of Trauma Nursing, 22(3), 176–181.

*DeBoer, M. I., Kothari, R., Kothari, M. A., et al. (2013). What are barriers to nurses screening for intimate partner violence? Journal of Trauma Nursing, 20(3), 155–160.

Dhungel, V., Liao, J., Raut, H., et al. (2015). Obesity delays functional recovery in trauma patients. Journal of Surgical Residency, 193(1), 415–420.

Edwards, C., Stephens-Stidham, S., Contreras, M. A., et al. (2016). Building the conversation for hospital-based injury prevention program capacity. Journal of Emergency Nursing, 42(2), 174–176.

Emergency Nurses Association (ENA). (2015a). Emergency nursing interface with mobile integrated health (MIH) and community paramedicine (CP) programs position statement. Retrieved on 1/14/2017 at: www.ena.org/SiteCollectionDocuments/Position%20Statements/MIHAndCP.pdf

Foresman-Capuzzi, J. (2014). CSI & U: Collection and preservation of evidence in the emergency department. Journal of Emergency Nursing, 40(3), 229–236.

Ghosh, S., Mukhopadhyay, P., Chatterjee, T. (2016).Management of snake bites in India. Journal of Association of Physicians of India, 64, 11–14.

Hess, J. J., Saha, S., & Luber, G. (2014). Summertime acute heat illness in U.S. emergency departments from 2006 through 2010: Analysis of a nationally representative sample. Environmental Health Perspectives, 122(11), 1209–1215.

Inaba, K., Siboni, S., Resnick, S., et al. (2015). Tourniquet use for civilian extremity trauma. Journal of Trauma, 79(2), 232–237.

Jabre, P., Belpomme, V., Azoulay, E., et al. (2013). Family presence during cardiopulmonary resuscitation. The New England Journal of Medicine, 368(11), 1008–1018.

Kane, I., Mitchell, A. M., Aiello, J., et al. (2016). Screening, brief intervention, and referral to treatment education for emergency nurses in 5 hospitals: Implementation steps and hurdles. Journal of Emergency Nursing, 42(1), 53–60.

*Leske, J. S., McAndrew, N. S., & Brasel, K. J. (2013). Experiences of families when present during resuscitation in the emergency department after trauma. Journal of Trauma Nursing, 20(1), 77–85.

Marathe, N., & Kumar, S. (2016). Epidemiological study of animal bite victims in Central India: a cross-sectional institutional study. International Journal of Community Medicine and Public Health, 3(1), 78–82.

Menezes, R. (2008). Rabies in India. Christian Medical association Journal, 178(5), 564–566.

Moore, K. (2015). Hot topics: Chemical burns in the emergency department. Journal of Emergency Nursing, 41(4), 364–365.

Musccal, E., & DeGuzman, M. M. (2016). Rhabdomyolysis. Medscape. Retrieved on 5/5/2017 at: www.emedicine.medscape.com/article/1007814-overview

National disaster management guidelines hospital safety, National Disaster management authority of India, Government of India, (2016). Retrieved on June 3rd, 2018, at: https://ndma.gov.in/images/guidelines/Guidelines-Hospital-Safety.pdf.

National Rabies Control Program, National guidelines on rabies prophylaxis, NCDC, (2015). Retrieved on June 3rd, 2018, at: http://pbhealth.gov.in/guideline%20for%20rabies%20prophylasix.pdf

National Institute on Drug Abuse. (2015a). Drug facts. Retrieved on 2/20/2017 at: www.drugabuse.gov/publications/drugfacts

National Institute on Drug Abuse. (2015b). Drug facts: What are synthetic cannabinoids? Retrieved on 2/20/2017 at: www.drugabuse.gov/publications/drugfacts/synthetic-cannabinoids

Oode, Y., Yanagawa, Y., Omori, K., et al. (2015). Analysis of patients with decompression illness transported via physician-staffed emergency helicopters. Journal of Emergency Trauma Shock, 8(1), 26–29.

Pinto, E. P. (2017). The jurisprudence of emergency medical care in India: an ethics perspective. **Indian Journal of Medical Ethics**, 2(4), p. 23. Retrieved on June 3rd, 2018, at: http://ijme.in/articles/the-jurisprudence-of-emergency-medical-care-in-india-an-ethics-perspective

Rui, P., Kang, K., & Albert, M. (2013). National Hospital Ambulatory Medical Care Survey: 2013 emergency department summary tables. Retrieved on 2/22/2017 at: www.cdc.gov/nchs/data/ahcd/nhamcs_emergency/2013_ed_web_tables.pdf

*Slain, T., Rickard-Aasen, S., Pringle, J. L., et al. (2014). Incorporating screening, brief intervention, and referral to treatment into emergency nursing workflow using an existing computerized physician order entry/clinical decision support system. Journal of Emergency Nursing, 40(6), 568–574.

Smith, S., Sammons, S. S., Carr, J., et al. (2014). Bedside management considerations in the treatment of pit viper envenomation. Journal of Emergency Nursing, 40(6), 537–545.

*Speroni, K. G., Fitch, T., Dawson, E., et al. (2014). Incidence and cost of nurse workplace violence perpetrated by hospital patients or patient visitors. Journal of Emergency Nursing, 40(3), 218–228.

Uttamdubey. (2021). Right to emergency medical services where do we stand. Retrieved on 05/23/2022 at: https://www.legalserviceindia.com/legal/article-2820-right-to-emergency-medical-services-in-india-where-do-we-stand-.html

Weinlein, J. C., Deaderick, S., & Murphy, R. F. (2015). Morbid obesity increases the risk for systemic complications in patients with femoral shaft fractures. Journal of Orthopaedic Trauma, 29(3), e91–e95.

Warrell, D. (2016). Guidelines for the management of snake bites.WHO SEARO publication, 2nd ed, New Delhi. Retrieved online on April 22nd, 2018, at: http://apps.searo.who.int/PDS_DOCS/B5255.pdf.

World Health Organization (WHO). (2016). Drowning: Fact sheet. Retrieved on 2/16/2017 at: www.who.int/mediacentre/factsheets/fs347/en/

Zafren, K. (2013). Frostbite: Prevention and initial management. High Altitude Medical Biology, 14(1), 9–12.

Resources

American College of Emergency Physicians (ACEP), www.acep.org

American College of Surgeons (ACS), Injury Prevention and Control, www.facs.org/quality-programs/trauma/ipc

American Heart Association, www.heart.org

American Red Cross, Prepare for Emergencies, www.redcross.org/get-help/prepare-for-emergencies/types-of-emergencies

American Trauma Society (ATS), www.amtrauma.org

CSIR Indian Institute of Toxicology Research, http://iitrindia.org

Divers Alert Network (DAN), www.diversalertnetwork.org

Emergency Nurses Association (ENA), www.ena.org

GVK Emergency Management and Research Institute, www.emri.in/

National Center for Health Statistics (NCHS), www.cdc.gov/nchs

National Human Trafficking Hotline, www.humantraffickinghotline.org

National Institute on Drug Abuse, www.drugabuse.gov/drugs-abuse/club-drugs

National Poison Information Centre, AIIMS, New Delhi,www.aiims.edu/en/departments-and-centers/central-facilities

National Safety Council, www.nsc.org

Society of Trauma Nurses (STN), www.traumanurses.org

CHAPTER 61

Terrorism, Mass Casualty, and Disaster Nursing

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Identify the necessary components of an emergency operations plan.
2. Discuss how triage in a disaster differs from triage in an emergency department.
3. Evaluate the different levels of personal protection and decontamination procedures that may be necessary during an event involving mass casualties or weapons of mass destruction.
4. Describe the physical injuries that may occur after blast events
5. Explain how to implement isolation precautions necessary for bioterrorism agents.
6. Compare and contrast the differences among various chemical agents used in terrorist events, their effects, and the decontamination and treatment procedures that are necessary.
7. Determine the injuries associated with varying levels of radiation or chemical exposure and the associated decontamination processes.

GLOSSARY

biologic weapon: a biologic agent that is used to spread disease among the general population or the military

chemical weapon: a chemical agent that is used to cause disability and mortality in the general population or the military

decontamination: process of removing, or rendering harmless, contaminants that have accumulated on personnel, patients, and equipment

disaster/mass casualty incident (MCI): a catastrophe or calamity which may be natural or manmade in which the number of casualties exceeds the number of available resources beyond the coping abilities of the affected community.

personal protective equipment (PPE): equipment beyond standard precautions; may include different levels of equipment to provide complete protection, depending on the nature of the suspected biologic, chemical or radiologic agent

radiologic weapon: by-products of radiation contamination that are used to cause morbidity and mortality in the general population or the military

terrorism: unlawful, systematic use of violence or threats of violence against people in order to coerce or intimidate

weapons of mass destruction (WMD): weapons used to cause widespread death and destruction

Introduction

The possibility and reality of mass casualties associated with disasters, terrorism, and biologic warfare are not new to human history, nor is the concept of using weapons of mass destruction (WMD) However, geopolitical forces and interests and the availability of destructive technology have brought the possibility of more terrorist events to our doorstep. Terrorism involves the systematic use of violence to create feelings of fear. Examples include the Mumbai terror attack on March 12, 1993, the destruction of the World Trade Center towers, and the damage to the Pentagon on September 11, 2001; the Delhi serial blast on October 29, 2005, the coordinated series of terrorist attacks in Mumbai for four days on November 26, 2008, and in Brussels on March 22, 2016. Since 2000, the number of deaths throughout the globe from terrorism equals the number of deaths from the bombing of Hiroshima in 1945 (Costa-Roberts, 2015). Terrorists have become increasingly sophisticated, organized, and therefore effective.

The U.S. Department of Homeland Security was created after the attacks of September 11, 2001, to coordinate federal and state efforts to combat terrorist activity. Similarly, in India, the disaster management act was passed in the parliament of India in 2005. This act enables coordinated, legally, and financially viable disaster management plan from center to peripheral community level. The preparation is based on the National disaster management guidelines which are effective in tackling both man terrorist events, as well as natural disasters.

Warfare, terrorism, and natural disasters are just some of the reasons nurses must plan for mass casualties. Airplane crashes, train crashes, toxic substance spills, and infectious disease outbreaks are other disasters that can result in mass casualties and tax the resources of health care facilities and their communities. Acute care facilities must be prepared for any and all of these disasters. This chapter focuses on disaster preparedness, including information about possible terrorist-related injuries and illnesses that can occur after, chemical, biologic and nuclear or radiation attacks. Information about the process that nurses should follow in order to respond to these emergencies is applicable to other types of mass disasters as well.

Central, State, and Local Responses to Emergencies

Many resources are available at the central, state, and local levels to assist in the disaster management and to provide emergency relief operations. A disaster is defined a catastrophe or calamity which may be natural or manmade in which the number of casualties exceeds the number of available resources to cope up (National Policy on Disaster Management, 2009). When resources to care for casualties become scarce, the greatest good for the greatest number of patients becomes the mode of operation (see Chart 61-1). Local communities must be prepared to act in isolation (i.e., called *sustainability planning*)

Chart 61-1 ETHICAL DILEMMA

Who Receives Care First During a Mass Casualty?

Case Scenario

You work as a staff nurse in the emergency department (ED) of a 75-bed community hospital. The unit is notified that an armed man entered the local social security office building and began shooting people in the lobby. There were numerous casualties, including the perpetrator, who was shot by a police officer. Within minutes of the notification, several patients are transported into the trauma bay area with gunshot wounds and other traumatic injuries. A young man appears to be hallucinating and attempts to assault a staff nurse. The perpetrator of the violent assault is transported into the trauma bay on a gurney, with an apparent gunshot wound to the head. An older woman grabs your arm and yells, "You have to take care of my husband first! He has a bad heart and may not be able to survive!" Another patient points at the perpetrator and yells, "He is the one who is responsible for this! How can you treat him?! He doesn't deserve to live!"

Discussion

One of the most difficult and morally distressing situations that nurses working in the ED may face is how to triage and treat patients when medical resources are scarce. Participating in disaster drills may prepare nurses working in the ED in how to respond if an emergency operations plan needs to be executed for a true mass casualty situation. These drills are intended to assist nurses in the ED to triage and prioritize care in a way that is unbiased. The key principle of triage in these situations is to do the greatest good for the greatest number of people. Medical resources must be distributed to patients in a fair and equitable manner.

Analysis

- Describe the ethical principles that are in conflict in this case (see Chapter 2, Chart 2-3). Which principle should have preeminence as you respond to the patient who feels the perpetrator does not have a right to receive medical care?
- Reflect upon your own desire to do good (i.e., practice beneficence) and how this desire to help an older couple may affect your triage decision. How would you respond to the wife? Should the age of her husband and his past medical history influence the triage process?
- How would you most appropriately triage the patient who has no visible physical injuries but is apparently experiencing a mental health crisis?

Resources

See Chapter 2, Chart 2-6 for ethics resources.

Abbasi, J. (2016). Expanding the health care response to mass violence. JAMA, 316(10), 1031–1033.

and provide competent care for up to 5 days before central or other state resources may become available (American College of Surgeons [ACS], 2010).

Disasters are categorized by type based upon anticipated use of resources and incident duration. A list of local resources with specific instructions about how and when to contact these agencies or organizations should be readily available to local disaster planning committees and frequently reviewed by those committees for necessary updates.

A disaster response strategy cannot succeed without appropriate physical assets and a staff trained and prepared to carry out the plan. Assets such as increased security; stockpiles of equipment and medications; and planning, drills, and training are essential (Veenema, 2013). Hazard vulnerability assessments should be performed to identify potential and actual threats that involve a particular facility and community. Mutual aid agreements among various communities must take these vulnerabilities into account. Successful execution of a response plan is based on knowledge, confidence, and readiness.

Disaster Management—Indian Perspective

India is susceptible to different types of natural and manmade disasters. 58.6% of the land area is prone to earthquakes of moderate to high degree. The states of Assam, West Bengal, parts of Odisha, Punjab are all flood prone. Figure 61-1A and B depicts high-risk areas for earthquake and cyclone of varying degrees respectively. The large hilly terrains have high risk of landslide and floods. States lying in the Himalayan ranges are at risk of avalanches. The country being in the tropical region is also prone to drought. India is also facing the threat of huge terrorist attacks and counter insurgency (National Policy on Disaster Management, 2009).

Disaster Management Cycle

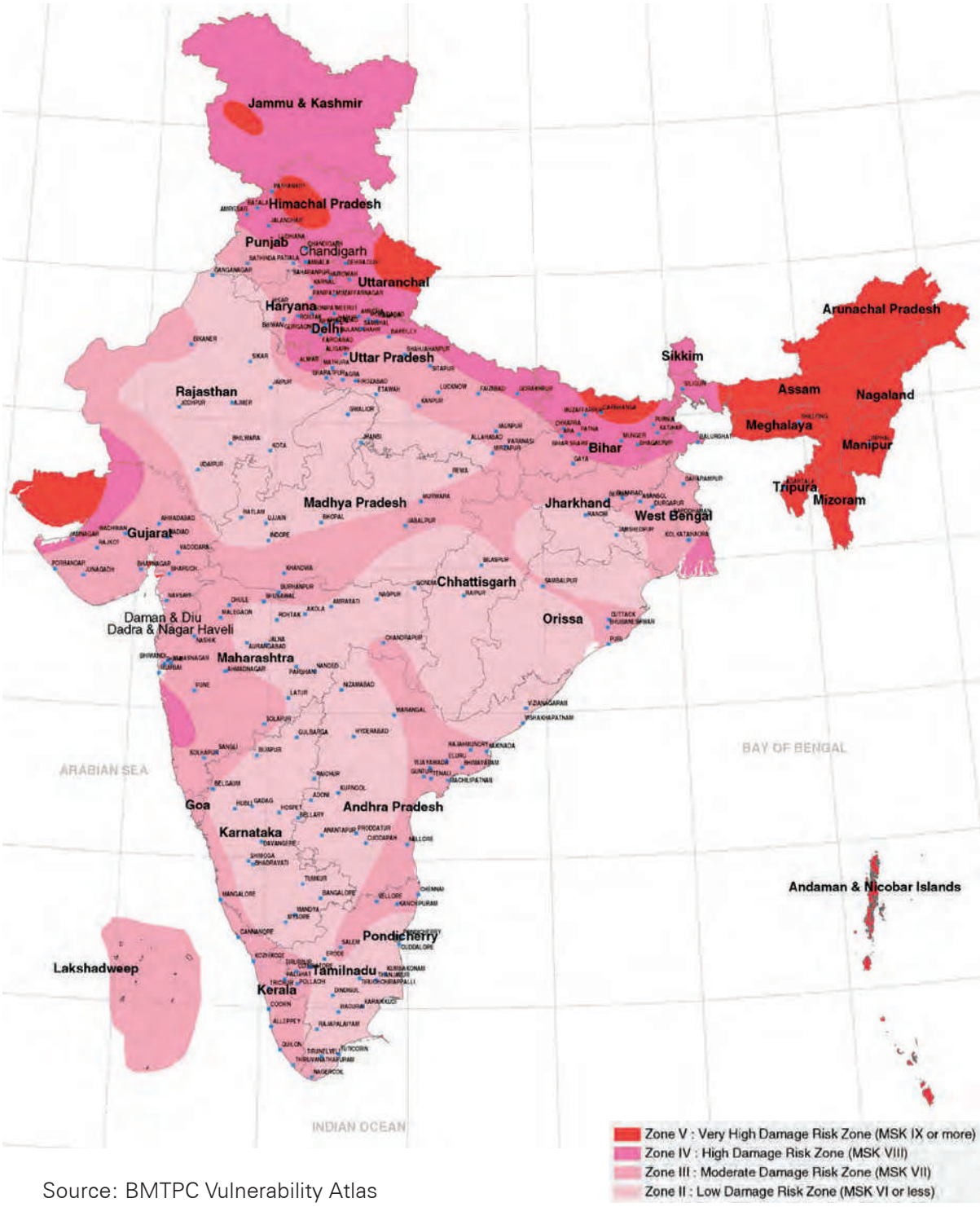
Disaster management can be described as a cyclic phenomenon. The cycle consists of disaster preparedness, mitigation and prevention, and risk reduction which are all activities in the proactive phase of a crisis or pre-disaster phase activities. The disaster response and rehabilitation and recovery are post-disaster phase activities. If the pre-disaster phase activities are sound, the post-disaster phase response and recovery can be faster, quicker, and nearly complete one (Fig. 61-2). The new disaster management policy envisions a sound disaster resilient India. Capacity building forms the backbone of the pre-disaster phase activities.

Disaster Management at Central Level

The Government of India has passed a legislation in 2005 called Indian Disaster Management Act. This act enabled integrated financially and legally viable coordinated functioning from the central to state, district, and local levels. The National Disaster Management Authority (NDMA) is the apex body working under the leadership of the Prime Minister of India. The NDMA aims at effective disaster preparation, mitigation, and prevention so that the loss of life and property is minimized. The NDMA takes all policy decisions related to disaster management. It has the authority to deal with all types of disasters, including chemical, biological, radiation and nuclear attacks, and terror attacks. The direction and control of National Disaster Response Force (NDRF) comes under the purview of the NDMA. The National Institute of Disaster Management is the premier institute constituted with the objective of capacity building at the central level and region wise in collaboration with various ministries (National Disaster Management Plan, 2016).

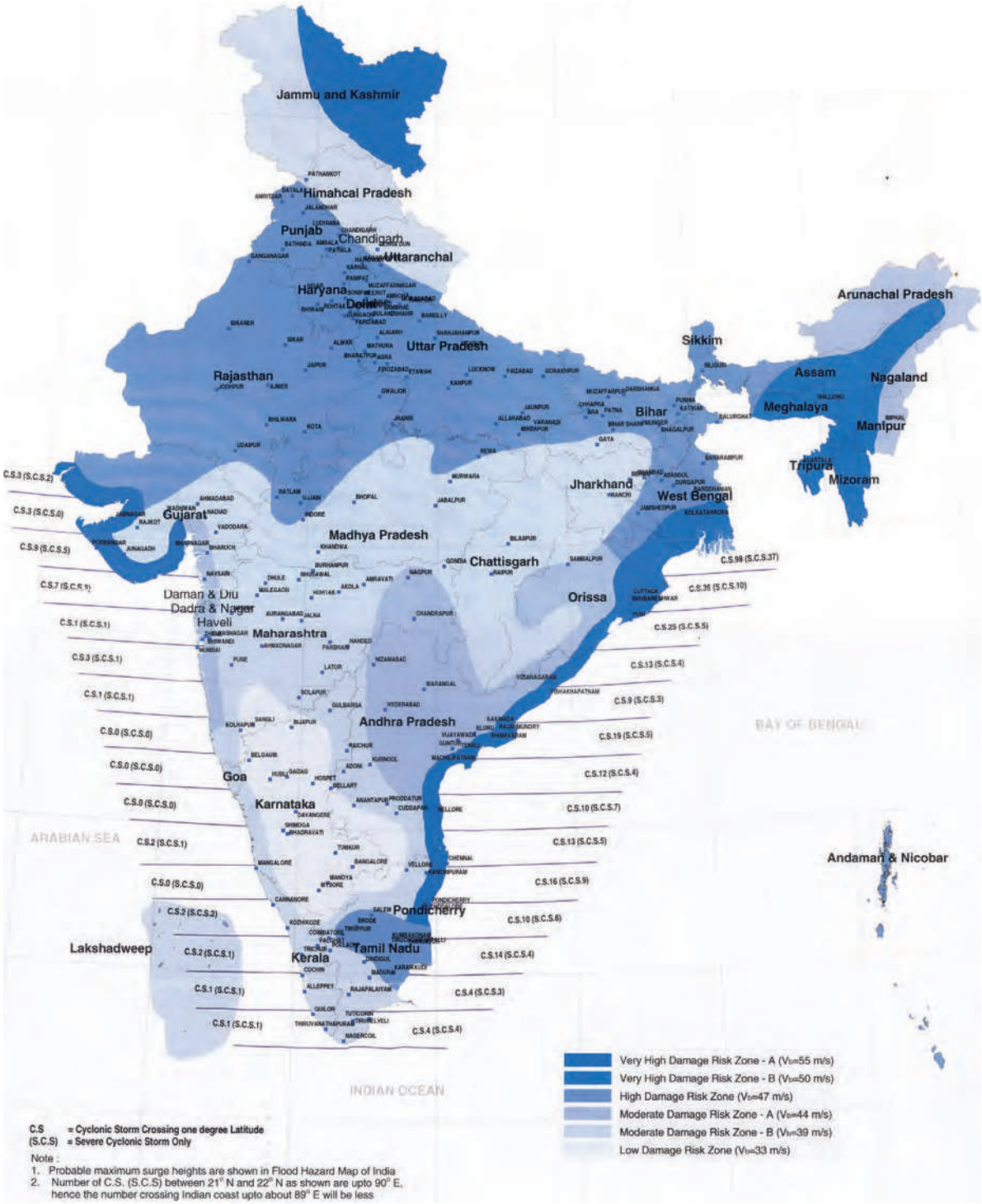
Various types of disasters are coordinated by Ministry of Home Affairs. The specific ministries and the type of disaster handled are as follows.

- Flood: Ministry of Water Resources



Source: BMTPC Vulnerability Atlas

Figure 61-1 • A. Earthquake zones in India. Adopted from National Policy on Disaster Management, 2009. Retrieved on 07/20/2018 at https://ndma.gov.in/images/guidelines/national-dm-policy2009.pdf. (*Continued*)



Source: BMTPC Vulnerability Atlas

Figure 61-1 • (*Continued*) **B**. Wind and cyclone zones in India. Adopted from National Policy on Disaster Management, 2009. Retrieved on 07/20/2018 at https://ndma.gov.in/images/guidelines/national-dm-policy2009.pdf.

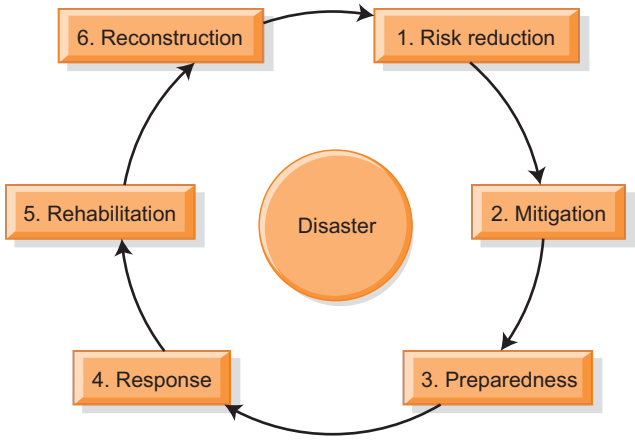


Figure 61-2 • Disaster management cycle.

- Drought: Ministry of Agriculture and Farmers' Welfare
- Cyclone/Tornado: Ministry of Earth Sciences/Ministry of Agriculture
- Biological weapons attack: Ministry of Health and Family Welfare
- Chemical and industrial disaster: Ministry of Environment, Forest and Climate Change
- Radiation and nuclear disaster: Ministry of Atomic Energy

At the central level, the agencies handling disaster management are cabinet committee for security, national executive committee, and the national crisis management committee. The cabinet committee on security appraises periodically the disaster preparedness, the possible threats, and the national security implications. The national crisis management committee controls, directs, coordinates, and evaluates the disaster relief responses following specific disaster. The national executive committee under the chairmanship of Home secretary assists NDMA in its activities (National Disaster Management Plan, 2016).

Disaster Management at the State, District, and Local Level

The Home Ministry, other respective ministries, and NDMA coordinate with the state governments and union territories in disaster management activities. The state government has a similar pattern of organization with the chief minister heading the State Disaster Management Authority (SDMA). The respective home affairs minister coordinate the activities at the state level. The state executive committee provides assistance to SDMA. Under the Disaster Management Act, the state government is expected to be prepared with state disaster relief force and has its own mechanism to mitigate disaster.

At the district level, collector is the head of District Disaster Management Authority (DDMA). At times of crisis, relief activities are carried out by the collector and the DDMA with the direction and assistance of central and state government. The central and state relief forces are deployed (National Disaster Management Plan, 2016).

In the case of a disaster, the district level hospital or a medical college hospital is set up as the nodal center. Nodal medical relief team has to be set up under the direction of district medical officer. There should be networking to mobilize the needed resources, men, and material. The collector has to work in coordination with private and corporate health care agencies, blood banks, and voluntary agencies. Police may involve in appropriate traffic control for quick mobilization of needed resources, control of rumors, law and order problems. Fire fighters, home guards, and civil defense volunteers have to be involved in rescue, salvage, and transportation of casualties (Guidelines for Hospital Emergency Preparedness Plan, 2008).

Hospital Emergency Preparedness Plans

Health care facilities are required by the Joint Commission to create a plan for emergency preparedness and to practice this plan at least twice a year (ACS Committee on Trauma [ACS-COT], 2014). In general, these plans are developed by the facility's safety/disaster management committee and are overseen by an administrative liaison.

Before the basic emergency operations plan (EOP) can be developed, the planning committee of the health care facility first evaluates characteristics of the community to identify the likely types of natural and manmade disasters that might occur. This hazard vulnerability analysis process is the responsibility of the local health care facility and its safety committee, safety officer, or emergency department (ED) manager. This information can be gathered by questioning local law enforcement, fire departments, and emergency medical systems and assessing the patterns of local train traffic, automobile traffic, and flood, earthquake, tornado, or hurricane activity. Consideration is also given to possible mass casualties that could arise because of the community's proximity to chemical plants, nuclear facilities, or military bases. Government, judicial, or financial buildings, schools, and any places where large groups of people gather can be considered high-risk areas.

The emergency preparedness planning committee must have a realistic understanding of its resources. It must determine, for example, whether the facility has or needs a pharmaceutical stockpile (e.g., vaccinations, antibiotics) available to treat specific chemical or biologic agents (ACS, 2010). Another scenario that might be anticipated may include the dispersal of a pulmonary intoxicant or choking agent, which would require that emergency operations planners determine how many ventilators are available within the facility and throughout the greater community. The committee might also outline how staff would triage and assign priority to patients when the number of ventilators is limited. Multiple factors influence a facility's ability to respond effectively to a sudden influx of injured patients, and the committee must anticipate various scenarios to improve its preparedness.

Components of the Emergency Operations Plan

The principles of emergency management must be a part of the EOP design and include a comprehensive plan for tackling all potential and actual hazards. The main goal is protection of the community. The EOP should be integrated with local, state, and central government plans and coordinated with the private sector and volunteers. It must be coordinated in advance to achieve a single common purpose, yet the plan must be flexible enough to adapt to any likely situation at hand. Predetermined organization is essential to minimize confusion, ensure that all key operations are directed, identify and correct flaws in the plan, and promote a well-coordinated response. Essential components of the EOP include the following (ACS, 2010):

- **Activation response:** The EOP activation response of a health care facility defines where, how, and when the response is initiated.

- **Internal/external communication plan:** Communication is critical for all parties involved, including communication to and from the prehospital arena.
- **Plan for coordinated patient care:** A response is planned for organized patient care into and out of the facility, including transfers from within the hospital to other facilities. The site of the disaster can determine where the greater number of patients may self-refer.
- **Security plans:** A coordinated security plan involving facility and community agencies is key to the control of an otherwise chaotic situation.
- **Identification of external resources:** Resources outside of the facility are identified, including local, state, and central government resources and information about how to activate these resources.
- **Plan for people management and traffic flow:** "People management" includes strategies to manage the patients, the public, the media, and personnel. Specific areas are assigned and a designated person is delegated to manage each of these groups
- **Data management strategy:** A data management plan for every aspect of the disaster will save time at every step. A backup system for documenting, tracking, and staffing is developed if the facility utilizes an electronic health record.
- **Demobilization response:** Deactivation of the response is as important as activation; resources should not be unnecessarily exhausted. The person who decides when the facility resumes daily activities is clearly identified. Any possible residual effects of a disaster must be considered before this decision is made.
- **After-action report or corrective plan:** Facilities often see increased volumes of patients 3 months or more after an incident. Postincident response must include a critique and a debriefing for all parties involved, immediately and again at a later date.
- **Plan for practice drills:** Practice drills that include community participation allow for troubleshooting any issues before a real-life incident occurs.
- **Anticipated resources:** Food and water must be available for staff, families, and others who may be at the facility for an extended period.
- **MCI planning:** MCI planning includes such issues as planning for mass fatalities and morgue readiness.
- **Education plan for all of the above:** A strong education plan for all personnel regarding each step of the plan allows for improved readiness and additional input for fine-tuning of the EOP.

As noted previously, hospitals are required to periodically hold disaster drills. Results from these drills can identify flaws within the EOP as well as unanticipated needs prior to any real disaster situation. Full-scale regional exercises that coordinate responses from both hospitals and emergency medical services (EMS) have been demonstrated as the most effective drills because they clearly identify breakdowns in communication (Nadworny, Davis, Miers, et al., 2014).

Initiating the Emergency Operations Plan

Notification of a disaster situation to a health care facility varies with each situation. In general, the notification to the facility comes from outside sources unless the initial incident occurred at the facility. The disaster activation plan should clearly state how the EOP is to be initiated. If communication is functioning, field incident command will give notice of the approximate number of patients who are arriving, although the number of patients who are self-referring will not be known.

Identifying Patients and Documenting Patient Information

Patient tracking is a critical component of casualty management. Disaster tags, which are numbered and include triage priority, name, address, age, location and description of injuries, and treatments or medications given, are used to communicate patient information. The tag should be securely placed on the patient and remain with the patient at all times. The tag number and the patient's name, if known, are recorded in a disaster log. The log is used by the command center to track patients, assign beds, and provide families with information.

Triage

Triage is the sorting of patients to determine the priority of their health care needs and the proper site for treatment. In non-disaster situations, health care workers assign a high priority and allocate the most resources to those who are the most critically ill (see Chapter 60). For example, under ordinary circumstances, a young adult who has a chest injury and is in cardiac arrest would receive advanced cardiopulmonary resuscitation, including medications, chest tubes, intravenous (IV) fluids, blood, and possibly emergency surgery in an effort to restore life. However, in a disaster, when health care providers are faced with a large number of casualties, the fundamental principle guiding resource allocation is to do the greatest good for the greatest number of people. Decisions are based on the likelihood of survival and consumption of available resources. Therefore, this same patient, and others with conditions associated with a high mortality rate, will be assigned a low triage priority in a disaster situation, even if the person is conscious. Although this may sound uncaring, from an ethical standpoint, the expenditure of limited resources on people with a low chance of survival, and denial of those resources to others with serious but treatable conditions, cannot be justified.

The triage officer rapidly assesses those injured at the disaster scene. Patients are immediately tagged and transported or given lifesaving interventions. One person performs the initial triage while other EMS personnel perform immediate lifesaving measures (e.g., intubation) and transport patients. Although EMS personnel carry out initial field triage, secondary and continuous triage at all subsequent levels of care is essential.

Staff should control all entrances to the acute care facility so that patients who are incoming are directed to the triage area first. Traffic control within the facility is one of the most important components of managing the disaster and resources (ACS, 2010). The triage area may be outside the entry or just at the door of the ED. This facilitates the triage of all patients—those arriving by medical transport and those who walk into the ED. Some patients who have already been seen in the field may be reclassified in the triage area based on their current presentation.

Triage categories separate patients according to severity of injury. A special color-coded tagging system is used during an MCI so that the triage category is immediately obvious. There are several triage systems in use across the country, and every nurse should be aware of the system used by their facility and community. The North Atlantic Treaty Organization (NATO) triage system is one that is widely used. It consists of four colors: red, yellow, green, and black. Each color signifies a

TABLE 61-1 Triage Categories During a Mass Casualty Incident

Triage Category	Priority	Color	Typical Conditions
Immediate: Injuries are life threatening but survivable with minimal intervention. Individuals in this group can progress rapidly to expectant if treatment is delayed.	1	Red	Sucking chest wound, airway obstruction secondary to mechanical cause, shock, hemothorax, tension pneumothorax, asphyxia, unstable chest and abdominal wounds, incomplete amputations, open fractures of long bones, and 2nd/3rd-degree burns of 15–40% total body surface area
Delayed: Injuries are significant and require medical care but can wait hours without threat to life or limb. Individuals in this group receive treatment only after immediate casualties are treated.	2	Yellow	Stable abdominal wounds without evidence of significant hemorrhage; soft tissue injuries; maxillofacial wounds without airway compromise; vascular injuries with adequate collateral circulation; genitourinary tract disruption; fractures requiring open reduction, débridement, and external fixation; most eye and central nervous system injuries
Minimal: Injuries are minor, and treatment can be delayed hours to days. Individuals in this group should be moved away from the main triage area.	3	Green	Upper extremity fractures, minor burns, sprains, small lacerations without significant bleeding, behavioral disorders or psychological disturbances
Expectant: Injuries are extensive, and chances of survival are unlikely even with definitive care. Persons in this group should be separated from other casualties, but not abandoned. Comfort measures should be provided when possible.	4	Black	Patients who are unresponsive with penetrating head wounds, high spinal cord injuries, wounds involving multiple anatomic sites and organs, 2nd/3rd-degree burns in excess of 60% of body surface area, seizures or vomiting within 24 hours after radiation exposure, profound shock with multiple injuries, agonal respirations; no pulse, no blood pressure, pupils fixed and dilated

Adapted from American College of Surgeons. (2010). Disaster management and emergency preparedness course. Chicago: Author.

different level of priority. Table 61-1 describes each category and gives examples of how different injuries would be classified (see Chapter 60).

Managing Internal Problems

The Red Cross has developed a basic survival/shelter resource kit; however, each facility must determine its supply lists based on its own needs assessment. The EOP committee should determine the top 10 critical medications used during normal day-to-day operations and then anticipate which other medications may be required in a disaster or an MCI. For example, the health care facility might plan to have available a stockpile of antidotes (e.g., cyanide kits) or antibiotics used in treating biologic agents. Information should be available about stocking or restocking any of the basic and special supplies, how those supplies are requested, and the time required to receive those supplies.

Communicating with the Media and Family

Communication is a key component of disaster management. Communication within the vast team of disaster responders is paramount; however, effective, informative communication with the media and worried family members is also crucial.

Managing Media Requests for Information

Although the media have an obligation to report the news and can play a significant positive role in communication, the number of reporters and newscasters and their support teams can be acute, possibly compromising operations and patient confidentiality. The disaster plan should include a clearly defined process for managing media requests, including a designated spokesperson, the public information officer, a site for the dissemination of information (away from patient care areas), and a regular schedule for providing updates.

The EOP helps prevent the release of contradictory or inaccurate information. Initial statements should focus on current efforts and what is being done to better understand the scope and impact of the situation. Information about casualties should not be released. Security staff should not allow media personnel access to patient care areas. However, media resources may be mobilized to notify the general population when disease containment is needed in case of an epidemic or the potential for one, including the location of shelters, necessity of quarantines, and point of dispensing units in the case of bioterrorism (ACS, 2010).

Caring for Families

Friends and family members converging on the scene must be cared for by the facility. The public information officer's role is to provide direction for the families and provide them with information as it becomes available. They may be feeling intense anxiety, shock, or grief and should be provided with information and updates about their loved ones as soon as possible and regularly thereafter. They should not be in the triage or treatment areas but in a designated area staffed by available social workers, counselors, or therapists. Access to this area should be controlled to prevent families from being disturbed. Information regarding loved ones can also be obtained at this time, which assists in identification of both the injured and deceased. Chart 61-2 discusses cultural variables to consider when coping with disaster-related injuries and death.

The Nurse's Role in Disaster Response Plans

Nurses make up the largest component of the health care workforce across the globe (Veenema, 2013). The role of the nurse during a disaster varies. Nurses may be asked to perform duties outside their areas of expertise and may take on responsibilities normally held by physicians or advanced practice nurses. For example, a critical care nurse may intubate a patient or even insert a chest tube. A nurse may perform wound débridement or suturing. A nurse may serve as the triage officer. In these situations, it is imperative that nurses strive to maximize patient safety and be aware of state regulations related to nursing practice (American Nurses Association, 2010).

Although the exact role of a nurse in disaster management depends on the specific needs of the facility at the time, it should

Chart 61-2

Cultural Considerations

Any disaster or mass casualty incident can be expected to involve members of diverse religious, ethnic, and cultural groups or may be targeted at and predominately affect a specific religious or ethnic group. Health care providers likewise include members of all religious, ethnic, and cultural backgrounds and should bear in mind that victims may have needs relating to the following:

- Language difficulties that increase fears and frustrations
- Specific religious practices related to medical treatment, hygiene, or diet
- Specific places/times for prayer
- Rituals about handling the dead
- Timing of funeral services
- Family roles and extended family importance
- Privacy

Some religious communities have plans for emergencies and disasters, and local hospitals should integrate these plans to the extent possible into their emergency operations plans.

Chart 61-3

Caring for People with Disabilities During a Disaster

When a disaster occurs, the multiple agencies involved attempt to provide food, water, and shelter to all those affected. People with disabilities have specific needs that require attention. It is recommended that people with disabilities have a personal support network to check on them after a disaster and to provide needed assistance. They should also have a backup system and an evacuation plan.

Evacuation assistance is imperative for people with disabilities. Directions to personal equipment (e.g., communication aids, medications, oxygen) should be available to rescue personnel. In a rapid evacuation, mobility devices, oxygen, suction, and medications will be needed at the shelters. Special efforts to keep those with vision or hearing impairment informed should be implemented. People skilled in sign language are also valuable resources during a disaster. On their websites, the American Red Cross and the National Organization on Disability provide information for disaster preparedness for people with disabilities (see the Resources section).

Adapted from U.S. Department of Homeland Security Federal Emergency Management Agency (FEMA) & the American Red Cross. (2004). *Preparing for disaster for people with disabilities and other special needs*. Retrieved on 11/26/2016 at: www.redcross.org/images/MEDIA_CustomProductCatalog/m4240199_A4497.pdf; World Health Organization. (2005). *Disasters, disability and rehabilitation*. Retrieved on 11/26/2016 at: www.who.int/violence_injury_prevention/other_injury/disaster_disability2.pdf

be clear which nurse or physician is in charge of a given patient care area and which procedures each individual nurse may or may not perform. Assistance can be obtained through the home guards or St Johns ambulance, and nonmedical personnel can provide services where possible. For example, family members can provide non skilled interventions for their loved ones. Nurses should remember that nursing care in a disaster focuses on essential care from a perspective of what is best for all patients. In addition, acquiring knowledge of the hospital disaster plan, participating in drills, and honing competencies relating to disaster management are essential (Emergency Nurses Association [ENA], 2014). Nurse leaders/administrators should be cognizant of potential security issues and assess and plan for surge capacity capability and in-house resources such as water, supplies, pharmaceuticals, and generator power. They also should predetermine means to evacuate the hospital if necessary, including an ultimate destination or destinations. The hospital must take into account in its plans shortages of all kinds—staff, medications, water/food, and equipment (ACS-COT, 2014); (ENA, 2014).

New settings and atypical roles for nurses arise during a disaster—for example, the nurse may provide shelter care in a temporary housing area or bereavement support and assistance with identification of deceased loved ones. People may require crisis intervention, or the nurse may participate in counseling other staff members and in Critical Incident Stress Management (CISM). Special care may be warranted for at-risk populations during a disaster (see Chart 61-3).

Managing Behavioral Issues

Although most people pull together and function well during a disaster, both people and communities suffer immediate and sometimes long-term psychological trauma that most often relates to fear and anxiety (ENA, 2014). Common responses to disaster include:

- Anxiety
- Depression
- Impaired performance
- Interpersonal conflicts
- Posttraumatic stress disorder
- Somatization (fatigue, general malaise, headaches, gastrointestinal disturbances, skin rashes)
- Substance abuse

Factors that influence a person's response to disaster include the degree and nature of the exposure to the disaster; loss of friends, family members, and pets; existing coping strategies; available resources and support; and the personal meaning attached to the event. Other factors, such as loss of home and valued possessions, extended exposure to danger, and exposure to toxic contamination, also influence response and increase the risk of adjustment problems. Those exposed to the dead and injured, those endangered by the event, older adults, children, emergency first responders, and health care personnel caring for victims are considered to be at higher risk for emotional sequelae. A person's normal response to stress and bereavement will also affect the response after a disaster. A bioterrorism attack can have psychological effects, resulting in psychogenic illnesses such as panic, fear, and/or anger (ENA, 2013).

Nurses can assist victims of disaster through active listening and providing emotional support, giving information, and referring patients to therapists or social workers. Health care workers must refer people to mental health care services because experience has shown that few victims of disaster seek these services, and early intervention minimizes psychological consequences. Nurses can also discourage victims from subjecting themselves to repeated exposure to the event through media replays and news articles, as well as encourage them to return to normal activities and social roles when appropriate (ENA, 2013).

Critical Incident Stress Management

CISM is an approach to preventing and treating the emotional trauma that can affect emergency responders as a consequence of their jobs and that can also occur to anyone involved in a disaster or MCI. CISM is handled by teams, which are available to the OEM. All branches of emergency services have CISM teams, as do the military and other industries (e.g., airline industry).

Components of a management plan include education (preparedness) before an incident occurs about critical incident stress and coping strategies; field support (ensuring that staff

get adequate rest, food, and fluids, and rotating workloads) during an incident; and defusings, debriefings, demobilization, supportive services to the family, and follow-up care after the incident (Veenema, 2013).

Defusing is a process by which the person receives education about recognition of stress reactions and management strategies for handling stress. Debriefing is a more complicated intervention; it involves a 2- to 3-hour process during which participants are asked about their emotional reactions to the incident, what symptoms they may be experiencing (e.g., flashbacks, difficulty sleeping, intrusive thoughts), and other psychological ramifications. In follow-up, members of the CISM team contact the participants of a debriefing and schedule a follow-up meeting if necessary. People with ongoing stress reactions are referred to mental health specialists.

Preparedness and Response

Recognition and Awareness

Preparedness for natural disasters and acts of terrorism includes devising specific community contingency plans that prepare residents, particularly those who are vulnerable (e.g., older adults, people with disabilities) for access to necessary life-sustaining resources and for evacuation, as necessary (see Chart 61-4). Preparedness also includes an awareness of the potential for covert use of WMD, self-protection, and early detection, containment, or decontamination of substances and agents that may affect others by secondary exposure. The strength of many toxins, mobility of many members of society, and long incubation periods for some organisms and diseases can result in an epidemic that can quickly and silently spread across the entire country. For example, a formerly healthy person with a rapid onset of flulike symptoms can have an ominous illness, such as anthrax (see later discussion).

Nurses should have a heightened awareness of trends that may suggest deliberate dispersal of toxic or infectious agents or pandemic onset that may include the following:

- An unusual increase in the number of people seeking care for fever, respiratory, or gastrointestinal symptoms
- Clusters of patients who present with the same unusual illness from a single location. For example, clusters can be from a specific geographic location, such as a city, or from a single sporting or entertainment event.
- A large number of fatalities, especially when death occurs within 72 hours after hospital admission
- Any increase in disease incidence in a normally healthy population. These cases should be reported to the directorate of public health at the state level.
- If any of these trends are noted, an extensive patient history is taken in an attempt to identify the possible agent involved. This history includes an occupational, work, and environmental assessment, in addition to the regular admission history. An exposure history contains, at a minimum, information about current and past exposures to possible hazards and an assessment of the patient's typical day and any deviations in routines. The work history includes, at a minimum, a description of all previous jobs, including short-term, seasonal, and part-time employment and any military service. The environmental history includes assessment of present and previous home locations, water supply, and any hobbies, to name a few factors. The admission history should include

Chart 61-4 NURSING RESEARCH PROFILE

Preparedness for Loss of Electricity After a Natural Disaster

Zidek, C., West, E., Holmes, J., et al. (2014). A survey comparison of rural versus urban residents and household preparedness. Home Healthcare Nurse, 32(7), 420–429.

Purpose

In 2012, the U.S. Department of Homeland Security began a national campaign to prepare citizens for emergencies, including natural disasters. In response to this, the Pennsylvania State Office of Homeland Security launched the *ReadyPA* campaign, which targeted Pennsylvanians deemed most vulnerable to adverse effects from a natural disaster, including older adults and citizens with disabilities. The aims of this study were to determine the effectiveness of *ReadyPA* in preparing rural and urban residents reliant on electronic medical equipment (ME) and rural and urban ME supply companies for natural disasters that cause loss of electrical power.

Design

This was a descriptive study that used a stratified random sample of adults who resided in one rural and one urban county and who had landline phone numbers listed in the phone book. Those ME supply companies that were listed in the white pages of those same rural and urban county phone books were all sampled. A telephone survey was designed that asked prospective participants whether they used electronic ME and to describe plans made to use ME in the event of power failure. Nursing students were trained to call prospective rural, urban, and ME supply company participants and began to gather data once Institutional Review Board approval was obtained.

Findings

Of the rural county participants (n = 958), 128 used electronic ME in their homes; whereas, of the urban county participants (n = 1000), 179 used electronic ME in their homes. Commonly used electronic ME included intravenous pumps, oxygen, blood glucose monitors, pressure-relieving mattresses, to name a few. There were eight rural ME and 24 urban ME supply companies that comprised the sample. Results included that 23% of rural participants and 45% of urban participants who used electronic ME had no home preparedness contingency plan made for loss of electrical power. Only 62.5% of both rural and urban ME supply companies indicated they were prepared to supply alternative ME to their users during periods of power failure. Furthermore, only half (50%) of rural ME supply companies and 12.5% of urban ME supply companies kept a nonelectronic list of their most vulnerable customers for retrieval during times of power failure.

Nursing Implications

Findings from this study suggest that one state's efforts to prepare its most vulnerable citizens to be prepared for loss of electrical power from a natural disaster has not resulted in widespread adoption of adequate preparatory practices. Despite the goals of the *ReadyPA* campaign, many Pennsylvanians who use electronic ME and their respective ME supply companies are not adequately prepared to respond to loss of power. Nurses must take the leadership initiative to launch advocacy efforts in their home communities to educate citizens who use electronic ME and the ME supply companies so that they make contingency plans for loss of electric power.

such information as recent travel and contact with others who have been ill or have recently died of a fatal illness. This is just a brief review of the extensive history that may need to be obtained to identify an exposure agent (Agency for Toxic Substances and Disease Registry, 2016).

Suspicions or findings are reported to the appropriate resources in the facility and to proper authorities in the community. Resources can include the infection control department, the state government, Department of Health and Family Welfare or Directorate of Public Health and Preventive Medicine. The district medical officer provides information to employees and health care providers regarding specific chemical agents; it includes the chemical name, physical data, chemical ingredients, fire and explosive hazard data, health and reactive data, spill or leak procedures, special protection information, and special precautions. Reporting furnishes data elements to those agencies responsible for epidemiology and response. Reporting also allows for sharing of information among facilities and jurisdictions and can help determine the source of infections or exposure and prevent further exposures and even deaths.

Personal Protective Equipment

Another component of preparedness and response involves the protection of the health care provider by additional personal protective equipment (PPE). Chemical or biologic agents and radiation are silent killers and are generally colorless and odorless. The purpose of PPE is to shield health care workers from the chemical, physical, biologic, and radiologic hazards that may exist when caring for patients who have been contaminated.

- **Level A** protection is worn when the highest level of respiratory, skin, eye, and mucous membrane protection is required. This includes a self-contained breathing apparatus (SCBA) and a fully encapsulating, vapor-tight, chemical-resistant suit with chemical-resistant gloves and boots.
- **Level B** protection requires the highest level of respiratory protection but a lesser level of skin and eye protection than with level A situations. This level of protection includes the SCBA and a chemical-resistant suit, but the suit is not vapor tight.
- **Level C** protection requires the air-purified respirator, which uses filters or sorbent materials to remove harmful substances from the air. A chemical-resistant coverall with splash hood, chemical-resistant gloves, and boots are included in level C protection.
- **Level D** protection is the typical work uniform.

Levels C and D PPE are the levels most often used in hospital facilities. Protective equipment must be donned before contact with a patient who has been contaminated. The acute care facility's standard precaution PPE (level D) generally is not adequate for protection from a patient who has been chemically, biologically, or radiologically contaminated. Level C PPE is adequate for the average patient exposure. The health care provider must use equipment that is capable of providing protection against the agent involved. This may mean using a splash suit along with a full-face positive- or negative-pressure respirator (a filter-type gas mask) or even an SCBA for medical personnel in the field.

No single PPE is capable of protecting against all hazards. Under no circumstances should responders wear any PPE without proper training, practice, and fit testing of respirator masks as necessary (Valdez, 2015).

Decontamination

Decontamination, the process of removing accumulated contaminants or rendering them harmless, is critical to the health and safety of health care providers by preventing secondary contamination. The decontamination plan should establish procedures and educate employees about decontamination procedures, identify the equipment needed and methods to be used, and establish methods for disposal of contaminated materials (Veenema, 2013).

Although many principles and theories surround decontamination of a patient, authorities agree that to be effective, decontamination must include a minimum of two steps. The first step is removal of the patient's clothing and jewelry and then rinsing the patient with water. Depending on the type of exposure, this step alone can remove a large amount of the contamination and decrease secondary contamination. The second step consists of a thorough soap-and-water wash and rinse. The hospital must be prepared to perform additional decontamination prior to entry into the facility. The hospital personnel may also treat "walking wounded" who did not receive any decontamination at the scene.

Nursing Alert: When patients arrive at the facility after being assessed and treated by a prehospital provider, it should not be assumed that they have been thoroughly decontaminated.

Natural Disasters

Natural disasters may result in mass casualties. Natural disasters can occur anywhere at any time and include events such as tornadoes, hurricanes, floods, avalanches, tidal waves (e.g., tsunamis), earthquakes, and volcanic eruptions (see Table 61-2). In the event of a natural disaster, loss of communications, potable water, and electricity is usually the greatest obstacle to a well-coordinated emergency response, and preparatory planning is essential. Wireless technology (e.g., cellular phones, computers, other communication devices) may not be functional.

The majority of the immediate casualties are trauma related. These mass casualties tax the trauma system to provide triage, transport of patients (in poor weather and road conditions), and management within the trauma centers. Most patients usually begin arriving within an hour of the event. However, the "walking wounded" may not seek care for 5 days to 2 weeks after the event or may seek care for injuries received during cleanup activities. Casualties arrive at hospitals in three waves. The first wave consists of people who are minimally (generally) injured who arrive of their own accord. The second wave consists of patients who are severely injured. The third wave consists of patients who are injured and who arrive after they are discovered by rescuers. For example, in the event of earthquakes, buildings collapse and cause the majority of fatalities from injuries primarily involving the head and chest (Veenema, 2013).

Excessive exposure to the natural elements and the need for food and water (by both patients and emergency responders) are critical issues. Without cover (e.g., buildings may be unsafe or destroyed) or potable water (e.g., water may be either contaminated or unavailable), injuries from exposure to heat, cold, or contaminated food or water can occur. Safety equipment that protects rescue workers from injury, exposure, and potentially dangerous animals (e.g., snakes, alligators, spiders) must be readily available. Rescue workers may also injure themselves in the process of extrication or cleanup (e.g.,

TABLE 61-2 Natural Disasters

Event	Issues and Injuries
Hurricanes	Causes flooding and tornadoes (see later discussion) Failure to evacuate Food and water safety *Injuries:* From recovery activities (e.g., chainsaws), stress-related disorders, and GI and other vector-borne disease; physical injury; bites from traumatized pets
Earthquakes	Associated with multiple aftershocks, tsunami Buildings require tethering in earthquake-prone areas *Injuries:* Physical injury; dehydration; pulmonary problems
Flooding	Can accompany other natural disasters Results in home and community destruction *Injuries:* Nonfatal drowning/drowning (e.g., people swept away in currents); waterborne and vector-borne disease (e.g., shigellosis, *Escherichia coli* infection, hepatitis A, giardiasis, leptospirosis, malaria, plague, dengue fever); physical injury from debris
Tsunami	As with flooding (above) but with much more rapid onset resulting in immediate large volume of water on land *Injuries:* Physical injury from debris; vector-borne disease (see the Flooding section); cholera
Tornadoes	Minimal warning, fast moving (approximately 50 km/hr and travel approximately 20 km) Massive destruction, shelter loss *Injuries:* Physical injury; blast like effects from pressure (see discussion of blast injuries in text)
Volcanic eruptions	Hazards from lava, openings in ground, gases, ash up to a 20 mile radius *Injuries:* Acid rain; toxic gases result in inhalation injury; physical injury
Exposure—heat/cold	*Cold:* Frostbite, hypothermia, (see Chapter 60) *Heat:* Burns (see Chapter 47), heat exhaustion/stroke (see Chapter 60)
Epidemic/Pandemic	Foodborne poisonings Acute outbreak, unexpected; local or distant transmission due to travel *Risk:* Determined by population density, travel, method of transmission *Illness:* Depends on organism involved (see Chapter 39)

Adapted from American College of Surgeons. (2010). Disaster management and emergency preparedness course. Chicago: Author; Veenema, T. G. (2013). Disaster nursing and emergency preparedness (3rd ed.). New York: Springer.

chain saws, building collapse). Hypothermia can occur rapidly in workers who are exposed to water at temperatures of 23.9°C (75°F) or less. As is true during all disasters, mental health workers and shelters are needed throughout the community. Veterinary assistance is also essential because pets are frequently abandoned and injured. In addition, emergency response workers must be prepared to treat the most common ailments experienced after exposure to a specific natural disaster. For instance, pulmonary problems peak with earthquakes and volcanic eruptions because of the increased particulate matter in the air. Most volcano-related deaths are from suffocation and exposure to noxious gases. After floods or water disasters, waterborne transmission of agents such as *Escherichia coli,* salmonella, shigella, typhoid, leptospirosis, malaria, and tularemia are common and cause widespread disease.

In some instances, early warning systems have assisted in decreasing the number of deaths from tornadoes and hurricanes. Even with the advent of early warning systems, some people are unable or unwilling to leave prior to the occurrence of the natural disaster.

When buildings collapse, rapid response to identify and remove trapped victims is the only means of improving survivability. There is a direct relationship between time trapped and survival; fewer than 50% of people survive if they are trapped more than 2 to 6 hours (ACS, 2010). Water-damaged buildings are not safe and require extensive examination before experts can ensure safe occupancy. Larger-scale issues that can cause significant later morbidity and mortality include the absence of water purification, waste removal, removal of human and animal remains, and vector control. Removal or disposal of biologic, chemical, and nuclear agents must also be considered.

Weapons of Terror

Although biologic, chemical, and radiologic events are not everyday events, they can occur at any facility, and every nurse needs to know the basics of caring for patients who have been affected. An explosion may spread dangerous material. Therefore, treatment of blast injuries must be anticipated and planned.

Blast Injury

A blast may result from terrorism but can also occur anywhere at any time if the right (or wrong) circumstances come together (e.g., welding inside of a tank that formerly contained tar but was not properly cleaned can result in an explosion as well as severe tar burns to the worker).

Types of Explosive Devices

The bomb most commonly utilized by terrorists is the pipe bomb, which contains low-velocity explosives and may also contain nails or other implements that cause more damage when the explosive ignites. Another type of commonly used explosive device is the Molotov cocktail, which uses a common flammable liquid such as gasoline in a glass bottle and a source of ignition, such as a rag. This forms a simple yet effective incendiary device. Other types of explosive devices include fertilizer bombs and dirty bombs, which include a radioactive source that spreads radiation after the initial blast.

Hazards following a bombing include secondary devices (set to explode at a predetermined time, typically after the arrival of rescue personnel); building collapse; contamination from biologic, chemical, or radiologic weapons; and the presence of terrorists among the patients and bystanders. The entire scene of the bombing is a crime scene and is treated as such. Triage of patients involved in a bombing is the same as for all disasters, with a heightened awareness that serious internal injuries from the blast wave may not be immediately evident.

Physical Injuries

Distance from the blast, whether the blast space was enclosed, composition of the explosive, whether a building collapsed, and the efficiency of medical resources available after the blast all affect patient outcomes after a blast injury. The actual blast that occurs during the initial seconds of the bombing or explosion causes a pressure wave or primary blast wave. Injuries can result from the impact of the explosion, the primary blast wave, or shrapnel (i.e., debris from the bomb). The majority of injuries

are caused by the primary blast wave (ACS, 2010). A blast wave has four effects. These include spalling, which refers to the pressure wave itself; implosion, which refers to rupture of organs from entrapped gases; shearing, which refers to the blast response of different body tissues, dependent on their density; and irreversible work, which refers to the presence of forces that exceed the tensile strength of an organ or tissue. If the blast occurs in an enclosed space, the wave has the opportunity to be reflected and thus amplified (Veenema, 2013). The various phases of blasts and related injuries are detailed in Table 61-3.

Although approximately 50% to 70% of deaths result from head injuries, most head injuries are not life threatening (ACS, 2010).

Blast Lung

Blast lung results from the blast wave as it passes through air-filled lungs. The result is hemorrhage and tearing of the lung, ventilation–perfusion mismatch, and possible air emboli. Typical signs and symptoms include dyspnea, hypoxia, tachypnea or apnea (depending on severity), cough, chest pain, and hemodynamic instability. Management involves providing respiratory support that includes administration of supplemental oxygen with nonrebreathing mask but may also require endotracheal intubation and mechanical ventilation. If a hemothorax or pneumothorax is present, a chest tube must be inserted to re-expand the lung. In the event of an air embolus, the patient should be immediately placed in the prone left lateral position to prevent migration of the embolus and will require emergent treatment in a hyperbaric chamber (CDC, 2012). Complications following blast lung can include respiratory failure as well as acute respiratory distress syndrome (see Chapters 11 and 12).

TABLE 61-3 Phases of Blasts and Associated Common Injuries

Phase of Blast Injury	Common Injuries
Primary: Results from pressure wave	Pulmonary barotraumas, including pulmonary contusions Head injuries, including concussion, other severe brain injuries Tympanic membrane rupture, middle ear injury Abdominal hollow organ perforation, hemorrhage
Secondary: Results from debris from the scene or shrapnel from the bomb	Penetrating trunk, skin, and soft tissue injuries Fractures, traumatic amputations
Tertiary: Results from pressure wave that causes the victim to be thrown	Head injuries Fractures, including skull
Quaternary: Results from pre-existing conditions exacerbated by the force of the blast or by postblast injury complications	Severe injuries with complex injury patterns—burns, crush injuries, head injuries Common pre-existing conditions that become exacerbated—COPD, asthma, cardiac conditions, diabetes, and hypertension

COPD, chronic obstructive pulmonary disease.

Adapted from Pennardt, A., & Lavonas, E. J. (2016). Blast injuries. Medscape. Retrieved on 4/2/2017 at: emedicine.medscape.com/article/822587-overview

Tympanic Membrane Rupture

TM rupture is the most frequent injury after subjection to a pressure wave because the TM is the body's most sensitive organ to pressure. There is an increased incidence of TM rupture when a blast occurs in close proximity to the patient and when it occurs in an enclosed space. Signs and symptoms include hearing loss, tinnitus, pain, dizziness, and otorrhea (CDC, 2012). The majority of TM ruptures heal spontaneously. Approximately 5% of patients with TM rupture from a blast will require hearing aids, whereas the majority will suffer only mild high-frequency hearing loss (Dodd-Murphy, 2014); (ENA, 2014). Other ear injuries may include ossicular disruption and impaction of foreign bodies.

Abdominal and Head Injuries

Blast abdomen may be evidenced by abdominal hemorrhage and internal organ injury. The typical signs and symptoms of internal abdominal injury can include pain, guarding, rebound tenderness, rectal bleeding, nausea, and vomiting (CDC, 2012) (see Chapter 60).

Head injuries are typically minor, but those that are severe result in the majority of post blast deaths. These injuries can occur without a direct blow to the head and may result from the blast itself, building collapse, or flying debris. Concussions commonly occur post blast, and the usual follow-up evaluation and treatment for post concussive syndrome is indicated (see Chapter 51). Approximately 30% of head injuries involve vascular structures (e.g., arteriovenous fistula, pseudoaneurysm, or dissection) (Veenema, 2013).

Special Populations

Special populations may have different blast-associated risks. For instance, older adults are particularly susceptible to bone fractures because they tend to have decreased bone density. They also tend to have more pre-existing morbid conditions that may be exacerbated by the explosion. Patients who are pregnant are particularly susceptible to placental shear forces that may result in abruptio placentae. People with mobility disabilities may have difficulty extricating themselves from the site of the blast (CDC, 2012).

Biologic Weapons

Biologic weapons are weapons that spread disease among the general population or the military. They can be used for sabotage, such as food or water contamination with a small target area, or may be used by global terrorists with intentions to enable global objectives.

Effects

Biologic weapons are easily obtained and easily disseminated and can result in significant mortality and morbidity (see Table 61-4). The potential use of biologic weapons calls for continuous increased surveillance by health departments and an increased index of suspicion by clinicians. Many biologic weapons result in signs and symptoms similar to those of common disease processes. Appropriate management of a biologic threat includes rapid recognition of the potential weapon; the use of proper PPE; decontamination, isolation, or quarantine of patients who are infected when appropriate; and the administration of appropriate vaccinations, antidotes, or medications to people at risk.

Biologic weapons are delivered in either a liquid or dry state, applied to foods or water, or vaporized for inhalation or direct

TABLE 61-4 Categories of Biologic Weapons

Category	Mortality and Morbidity	Examples of Biologic Agents That May Be Weaponized
Category A	High mortality	*Bacillus anthracis* (anthrax) *Clostridium botulinum* (botulism) *Francisella tularensis* (tularemia) Viral hemorrhagic fevers (e.g., dengue, Ebola) Variola (i.e., smallpox) *Yersinia pestis* (plague)
Category B	Low mortality, moderate morbidity	*Brucella* species (brucellosis) *Coxiella burnetii* (Q fever) *Staphylococcus aureus, Vibrio* species (food poisoning) *Rickettsia typhi* (typhus) Arboviruses (viral encephalitis) *Cryptosporidium parvum* (Cryptosporidiosis)
Category C	Low mortality, low morbidity	Hantavirus

Adapted from Veenema, T. G. (2013). Disaster nursing and emergency preparedness (3rd ed.). New York: Springer.

contact. Vaporization may be accomplished through spray or explosives loaded with the weapon. Because of increases in business and pleasure travel by people in industrialized nations, a biologic weapon could be released in one city and affect people in other cities thousands of miles away. The vector can be an insect, animal, or person, or there may be direct contact with the weapon itself.

Two of the biologic agents most likely to be used or weaponized are discussed in the next section. Table 61-5 describes other easily weaponized biologic agents.

Types

Anthrax

Anthrax is recognized as the most likely weaponized biologic agent available and has been recognized as a highly debilitating agent for centuries. *Bacillus anthracis* is a naturally occurring gram-positive, encapsulated rod that lives in the soil in the spore state throughout the world. The bacterium sporulates (i.e., is liberated) when exposed to air and is infective only in the spore form. Contact with infected animal products (raw meat) or inhalation of the spores results in infection. Cattle and other herbivores are vaccinated against anthrax to prevent transmission through contaminated meat. As an aerosol, anthrax is odorless and invisible and can travel a great distance before disseminating; hence, the site of release and the site of infection can be miles apart.

Clinical Manifestations

Anthrax is caused by replicating bacteria that release toxin, resulting in hemorrhage, edema, and necrosis. The incubation period is 1 to 6 days. There are three main methods of infection: skin contact, gastrointestinal ingestion, and inhalation. Skin lesions (the most common infection) cause edema with pruritus and macule or papule formation, resulting in ulceration with 1- to 3-mm vesicles. A painless eschar develops, which falls off in 1 to 2 weeks (Auerbach, 2017).

Ingestion of anthrax results in fever, nausea and vomiting, abdominal pain, bloody diarrhea, and occasionally ascites. If severe diarrhea develops, decreased intravascular volume becomes the major treatment concern. The bacterium targets the terminal ileum and cecum. Sepsis can occur.

Inhaling anthrax results in severe clinical manifestations. Its symptoms mimic those of the flu, and usually treatment is sought only when the second stage of severe respiratory distress occurs. Antibiotic therapy does not halt the progress of the disease. Inhaled anthrax can incubate for up to 60 days, making it difficult to identify its source. Initial signs and symptoms include cough, headache, fever, vomiting, chills, weakness, mild chest discomfort, dyspnea, and syncope, without rhinorrhea or nasal congestion. Most patients have a brief recovery period followed by the second stage within 1 to 3 days, characterized by fever, severe respiratory distress, stridor, hypoxia, cyanosis, diaphoresis, hypotension, and shock. These patients require optimization of oxygenation, correction of electrolyte imbalances, and ventilatory and hemodynamic support. More than 50% of these patients have hemorrhagic mediastinitis on a chest x-ray (a hallmark sign). The disease can also progress to include meningitis with subarachnoid hemorrhage. Death results approximately 24 to 36 hours after the onset of severe respiratory distress. The mortality rate approaches 100% (Auerbach, 2017).

Treatment

At present, anthrax is penicillin sensitive; however, strains of penicillin-resistant anthrax are thought to exist. Recommended treatment includes penicillin (Penicillin V), erythromycin (Erythrocin), gentamicin (Garamycin), or doxycycline (Vibramycin). If antibiotic treatment begins within 24 hours after exposure, death can be prevented. In a mass casualty situation, treatment with ciprofloxacin (Cipro) or doxycycline is recommended, because these easily given oral antibiotic agents are stockpiled and there should be sufficient dosages to fully treat many patients who have been anthrax-exposed. Treatment is continued for 60 days. For patients who have been directly exposed to anthrax but have no signs and symptoms of disease, ciprofloxacin or doxycycline is used for prophylaxis for 60 days (Auerbach, 2017).

Standard precautions are the only ones indicated to protect the caregiver exposed to a patient infected with anthrax. The patient is not contagious, and the disease cannot spread from person to person. Equipment should be cleaned using standard hospital disinfectant. After death, cremation is recommended because the spores can survive for decades and represent a threat to morticians and forensic medicine personnel. There is a vaccine for anthrax that has been used in the military; however, it is not yet widely used because it requires multiple time-interval–sensitive boosters.

Smallpox

Smallpox (variola) is classified as a deoxyribonucleic acid (DNA) virus. It has an incubation period of approximately 12 days. It is extremely contagious and is spread by direct contact, by contact with clothing or linens, or by droplets from person to person only after the fever has decreased and the rash phase has begun. Aerosolization of the virus would result in widespread dissemination.

The World Health Organization (WHO) declared smallpox eradicated in 1977 and stopped worldwide vaccination in 1980. Therefore, a large portion of the current population has no immunity to the virus. A smallpox vaccination plan introduced

TABLE 61-5 Selected Examples of Biologic Agents That Can Be Used As Weapons

Agent/Organism	Contagion	Decontamination and Protective Equipment	Signs and Symptoms	Treatment (Mortality Rate)
Tularemia—*Francisella tularensis:* Gram-negative coccobacillus, one of the most infectious bacteria known.	Direct contact with infected animals or aerosolized as a bioterror weapon; bites Not contagious through human-to-human contact Found in Oklahoma, Missouri, Arkansas	Standard barrier precautions. Clothing and linens should be laundered under the usual hospital protocol.	*Initial:* Abrupt onset of fever, fatigue, chills, headache, lower backache, malaise, rigor, coryza, dry cough, and sore throat without adenopathy. Nausea and vomiting or diarrhea possible. *As disease progresses:* Sweating, fever, progressive weakness, anorexia, and weight loss demonstrate continued illness. *Mortality secondary to:* Pneumonitis (if inhalation is the source) with copious watery or purulent sputum, hemoptysis, respiratory insufficiency, sepsis, and shock.	Streptomycin or gentamicin/aminoglycoside for 10–14 days. Inhalation tularemia must be treated within 48 hours of onset. In mass casualty situations, doxycycline or ciprofloxacin is recommended. For persons exposed to tularemia, tetracycline or doxycycline is recommended for 14 days. (Mortality rate = 2%)
Botulism—*Clostridium botulinum:* Botulinum blocks acetylcholine-containing vesicles from fusing with the terminal membranes of the motor neuron end-plate, resulting in a flaccid paralysis.	Direct contact Not contagious through human-to-human contact	Any skin exposure to the botulism toxin can be treated with soap and water or a 0.1% hypochlorite solution. Standard precautions are used when treating patients with botulism.	*Gastrointestinal botulism:* Abdominal cramps, nausea, vomiting, and diarrhea *Inhalation botulism:* Fever; symmetric descending flaccid paralysis with multiple cranial nerve palsies. *Classic signs and symptoms include* diplopia, dysphagia, dry mouth, lack of fever, and alert mental status. *Other possible symptoms include* ptosis of the eyelids, blurred vision, enlarged sluggish pupils, dysarthria, and dysphonia. *Mortality secondary to:* Airway obstruction and inadequate tidal volume	Supportive ventilatory therapy is necessary if respiratory infection occurs. Aminoglycosides and clindamycin are contraindicated because they exacerbate neuromuscular blockage. Equine antitoxin is used to minimize subsequent nerve damage. There is a 2% rate of anaphylaxis to the antitoxin; therefore, diphenhydramine (Benadryl) and epinephrine must be immediately available for use. Supportive care—mechanical ventilation, nutrition, fluids, prevention of complications (Mortality rate = 5%).
Plague—*Yersinia pestis:* nonsporulating gram-negative coccobacillus. The bacterium causes destruction and necrosis of the lymph nodes.	Contagious *Bubonic plague:* Transmitted through flea bites with no person-to-person transmission *Pneumonic plague:* Transmitted through respiratory droplet contact	Isolation barrier precautions with full face respirators; the patient should wear a mask. Rooms should receive a terminal cleaning. Clothing and linens with body fluids on them should be cleaned with the usual disinfectant. Routine precautions should be used in the case of death.	*Bubonic plague:* Sudden fever and chills, weakness, a swollen and tender lymph node (bubo) in the groin, axilla, or cervical area. The resultant bacteremia progresses to septicemia from the endotoxin and, finally, shock and death. *Primary septicemic plague:* Disseminated intravascular coagulation, necrosis of small vessels, purpura, and gangrene of the digits and nose (black death). *Pneumonic plague:* Severe bronchospasm, chest pain, dyspnea, cough, and hemoptysis. There is a 100% mortality associated with pneumonic plague if not treated within the first 24 hours.	Streptomycin or gentamicin for 10–14 days. Start within 12–24 hours. Tetracycline or doxycycline is an acceptable alternative if an aminoglycoside cannot be given. People with close contact exposure (<2 m) require prophylaxis with doxycycline for 7 days. (Mortality rate = 50%)

Adapted from Dire, D. J. (2016). CBRNE—Biological warfare agents. Medscape. Retrieved on 11/26/2016 at: emedicine.medscape.com/article/829613-overview; Emergency Nurses Association. (2013). Sheehy's manual of emergency care (7th ed.). St. Louis, MO: Elsevier Mosby; Emergency Nurses Association. (2014). Trauma nursing core course (7th ed.). Chicago: Author; and Veenema, T. G. (2013). Disaster nursing and emergency preparedness (3rd ed.). New York: Springer.

in 2003 proposed that a designated number of ED staff receive the first vaccinations to ensure that ED staff would be immunized in the event of a smallpox outbreak. The government estimated that 0.1% of those people receiving the vaccine would have serious side effects. Of these, approximately 4% would have life-threatening complications, and 0.1% would die. Currently, only people with a high likelihood of exposure to smallpox are encouraged to receive the vaccination (CDC, 2016).

Clinical Manifestations

Signs and symptoms of smallpox infection include high fever, malaise, headache, backache, and prostration. After 1 to 2 days, a maculopapular rash appears, evolving at the same rate, beginning on the face, mouth, pharynx, and forearms. Only then does the rash progress to the trunk and also become vesicular to pustular (Veenema, 2013). There is a large amount of the virus in the saliva and pustules. Smallpox is contagious only after the appearance of the rash. There are two forms of smallpox: variola major and variola minor. Variola major is more common, results in a higher fever and more extensive rash, and has a 30% case fatality rate (i.e., the likelihood of fatality per case diagnosed). Hemorrhagic smallpox, a subtype of variola major, includes all of the above signs and symptoms plus a dusky erythema and petechiae leading to frank hemorrhage of the skin and mucous membranes, and it results in death by day 5 or 6 (Veenema, 2013).

Treatment

Treatment includes supportive care with antibiotic agents for any additional infection. The patient must be isolated with the use of transmission precautions. Laundry and biologic wastes should be autoclaved before being washed with hot water and bleach. Standard decontamination of the room is effective. All people who have household or face-to-face contact with the patient after the fever begins should be vaccinated within 4 days to prevent infection and death. A patient with a temperature of 38°C (101°F) or higher within 17 days after exposure must be placed in isolation. Cremation is preferred for all deaths, because the virus can survive in scabs for up to 13 years (Veenema, 2013).

Chemical Weapons

Chemical weapons may be used as agents in warfare or for terrorist purposes; they are overt agents in that the effects are more apparent and occur more quickly than those caused by biologic weapons (see Table 61-6). Poisonous exposure to everyday chemicals also may occur; the same management principles discussed later apply when patients are exposed to these chemical agents even when not used as weapons. Typical exposures in these instances include industrial chemicals, gasoline, turpentine, kerosene, and insecticides (ENA, 2014).

Characteristics of Chemicals

Volatility

Volatility is the tendency for a chemical to become a vapor. The most common volatile agents are phosgene and cyanide. Most chemicals are heavier than air, except for hydrogen cyanide. Therefore, in the presence of most chemicals, people should stand up to avoid heavy exposure (because the chemical will sink toward the floor or ground).

TABLE 61-6 Common Chemical Agents

Agent	Action	Signs and Symptoms	Decontamination and Treatment
Nerve Agents			
Sarin Soman	Inhibition of cholinesterase	Increased secretions (salivation, lacrimation, emesis, urination), gastrointestinal motility, diarrhea, bronchospasm	Soap and water Supportive care Benzodiazepines Pralidoxime Atropine
Blood Agent			
Cyanide	Inhibition of aerobic metabolism	Inhalation—tachypnea, tachycardia, coma, seizures; bright red skin; can progress to respiratory arrest, respiratory failure, cardiac arrest, death	Soap and water Sodium nitrite Sodium thiocyanate Amyl nitrate Hydroxocobalamin
Vesicant Agents			
Lewisite Sulfur mustard Nitrogen mustard Phosgene	Blistering agents	Superficial to partial-thickness burn with vesicles that coalesce; conjunctivitis, nasal irritation	Soap and water Blot; do not rub dry
Pulmonary Agents			
Phosgene Chlorine	Separation of alveoli from capillary bed	Pulmonary edema, bronchospasm, chest tightness, burning sensation, blurry vision; Phosgene can result in pain, then blisters followed by partial to full-thickness burn	Copious flushing Move to fresh air—away from gases Airway management Ventilatory support Bronchoscopy

Adapted from Ciottone, G. R., & Arnold, J. L. (2015). CBRNE – Chemical warfare agents. Medscape. Retrieved on 11/26/2015 at emedicine.medscape.com/article/829454-overview; Emergency Nurses Association. (2013). Sheehy's manual of emergency care (7th ed.). St Louis, MO: Elsevier Mosby; Emergency Nurses Association. (2014). Trauma nursing core course (7th ed.). Chicago: Author; and Veenema, T. G. (2013). Disaster nursing and emergency preparedness (3rd ed.). New York: Springer.

Persistence

Persistence means that the chemical is less likely to vaporize and disperse. More volatile chemicals do not evaporate very quickly. Most industrial chemicals (e.g., cyanide) are not very persistent. Weaponized agents (chemicals developed as weapons by the military or terrorists [e.g., mustard gas]) are more likely than industrial chemicals to penetrate skin and mucous membranes and also cause secondary exposure.

Toxicity

Toxicity is the potential of an agent to cause injury to the body. The median lethal dose (LD_{50}) is the amount of the chemical that will cause death in 50% of those who are exposed. For example, cyanogen chloride has the highest LD_{50}, twice that of hydrogen cyanide and eight times higher than sulfur mustard (ACS, 2010). The median effective dose (ED_{50}) is the amount of the chemical that will cause signs and symptoms in 50% of those who are exposed. The concentration time (CT) is the concentration released multiplied by the time exposed (in milligrams per minute). For example, if 1000 mg of a chemical is released and the time a person is exposed to this amount of chemical is 10 minutes, then the CT would be 10,000 mg/min.

Latency

Latency is the time from absorption to the appearance of signs and symptoms. Sulfur mustards and pulmonary agents have the longest latency, whereas other vesicants, nerve agents, and cyanide produce signs and symptoms within seconds.

Limiting Exposure

Evacuation is essential, as is removal of the person's clothing and decontamination as close to the scene as possible and before transport of the person who has been exposed. Soap and water are effective means of decontamination in most cases. Staff involved in decontamination efforts must wear PPE and contain and dispose of the runoff after decontamination procedures (ENA, 2013).

Types of Chemicals

Vesicants

Vesicants are chemicals that cause blistering and result in burning, conjunctivitis, bronchitis, pneumonia, hematopoietic suppression, and death. Examples of vesicants include lewisite, phosgene, nitrogen mustard, and sulfur mustard. In World War I and in the Iran–Iraq conflict of 1980 to 1988, vesicants were used to disable opponents. Vesicants were the main incapacitating agents, resulting in minimal (less than 5%) death but large numbers of injuries (Veenema, 2013). Liquid sulfur mustard was the most frequently used vesicant in these conflicts.

Clinical Manifestations

The initial presentation after exposure to a vesicant is similar to that of a large superficial to partial-thickness burn in the warm and moist areas of the body (i.e., perineum, axillae, antecubital spaces). There is stinging and erythema for approximately 24 hours, followed by pruritus, painful burning, and small vesicle formation after 2 to 18 hours. These vesicles can coalesce into large, fluid-filled bullae. Lewisite and phosgene result in immediate pain after exposure. Tissue damage occurs within minutes.

If the eye is exposed, there is pain, photophobia, lacrimation, and decreased vision. This progresses to conjunctivitis, blepharospasm, corneal ulcer, and corneal edema.

Respiratory effects are more serious and often are the cause of mortality with vesicant exposure. Purulent fibrinous pseudomembrane discharge may cause obstruction of the airways. Bacterial pneumonia may be the cause of death within approximately a week of pulmonary exposure (ACS, 2010). Gastrointestinal exposure may cause nausea and vomiting, leukopenia, and upper gastrointestinal bleeding.

Treatment

Appropriate decontamination includes soap and water. Scrubbing and the use of hypochlorite solutions should be avoided because they increase penetration. Once the substance has penetrated, it cannot be removed. Eye exposure requires copious irrigation. For respiratory exposure, intubation and bronchoscopy to remove necrotic tissue are essential. With lewisite exposure, dimercaprol (BAL In Oil) is administered IV for systemic toxicity and topically for skin lesions. All persons with sulfur mustard exposures should be monitored for 24 hours for delayed (latent) effects (ENA, 2013).

Nerve Agents

The most toxic agents in existence are the nerve agents such as sarin, soman, tabun, and VX. They are inexpensive, effective in small quantities, and easily dispersed. In the liquid form, nerve agents evaporate into a colorless, odorless vapor. Organophosphates (pesticides) are similar in nature to the nerve agents used in warfare and are readily available in the farming industry.

Nerve agents can be inhaled or absorbed percutaneously or subcutaneously. These agents bond with acetylcholinesterase so that acetylcholine is not inactivated; the adverse result is continuous stimulation (hyperstimulation) of the nerve endings. Carbamates, which are insecticides originally extracted from the Calabar bean, are derivatives of carbamic acid; they are nerve agents that specifically inhibit acetylcholinesterase for several hours and then spontaneously become unbound from the acetylcholinesterase. However, organophosphates require the formation of new enzyme (acetylcholinesterase) before nervous system function can be restored.

A very small drop of a nerve agent is enough to result in sweating and twitching at the site of exposure. A larger amount results in more systemic symptoms. Effects can begin anywhere from 30 minutes up to 18 hours after exposure. The more common organophosphates and carbamates (e.g., Sevin and malathion) that are used in agriculture result in less severe symptoms than do those used in warfare or in terrorist attacks. In an ordinary situation (e.g., nonwarfare, nonterrorist attack situation), a patient could arrive at the ED having been unintentionally exposed to organophosphates or intentionally exposed to these agents in a suicidal attempt (ENA, 2013).

Clinical Manifestations

Signs and symptoms of nerve gas exposure are those of cholinergic crisis and include bilateral miosis, visual disturbances, increased gastrointestinal motility, nausea and vomiting, diarrhea, substernal spasm, indigestion, bradycardia and atrioventricular block, bronchoconstriction, laryngeal spasm, weakness, fasciculations, and incontinence. The patient must be examined in a dark area to truly identify miosis. Neurologic responses include insomnia, forgetfulness, impaired judgment, depression, and irritability. A lethal dose results in loss of consciousness, seizures, copious secretions, fasciculations, flaccid muscles, and apnea (ENA, 2014).

Treatment

Decontamination with copious amounts of soap and water or saline solution for 8 to 20 minutes is essential. The water is blotted off, not wiped off, the skin. Wiping may have the unintended effect of rubbing more of the agent into the skin. Fresh 0.5% hypochlorite solution (bleach) can also be used. The airway is maintained, and suctioning is frequently required. Plastic airway equipment should not be used, because plastic will absorb sarin gas and may result in continued exposure to the agent.

Atropine 2 to 4 mg is administered by IV, followed by 2 mg every 3 to 8 minutes for up to 24 hours of treatment. Alternatively, IV atropine 1 to 2 mg per hour may be given until clear signs of anticholinergic activity have returned (decreased secretions, tachycardia, and decreased gastrointestinal motility). Another medication that may serve as an antidote is pralidoxime (Protopam), which allows cholinesterase to become active against acetylcholine. Pralidoxime 1 to 2 g in 100 to 150 mL of normal saline solution is given over 15 to 30 minutes. Pralidoxime has no effect on secretions and may have any of the following side effects: hypertension, tachycardia, weakness, dizziness, blurred vision, and diplopia. Diazepam (Valium) or other benzodiazepines are used to control seizures, to decrease fasciculations, and to alleviate apprehension and agitation (ENA, 2013).

Blood Agents

Blood agents such as hydrogen cyanide and cyanogen chloride have a direct effect on cellular metabolism, resulting in asphyxiation through alterations in hemoglobin. Cyanide is an agent that has profound systemic effects. It is commonly used in the mining of gold and silver and in the plastics and dye industries.

A cyanide release is often associated with the odor of bitter almonds. In house fires, cyanide is released during the combustion of plastics, rugs, silk, furniture, and other construction materials. There is a significant correlation between blood cyanide and carbon monoxide levels in patients who survive fires, and in some cases, the cause of death is cyanide poisoning.

Clinical Manifestations

Cyanide can be ingested, inhaled, or absorbed through the skin and mucous membranes. Cyanide is protein bound and inhibits aerobic metabolism, leading to respiratory muscle failure, respiratory arrest, cardiac arrest, and death. Its inhalation results in flushing, tachypnea, tachycardia, nonspecific neurologic symptoms, stupor, coma, and seizure preceding respiratory arrest (ENA, 2014).

Treatment

Rapid administration of amyl nitrate, sodium nitrite, and sodium thiosulfate is essential to the successful management of cyanide exposure. First, the patient is intubated and placed on a ventilator. Next, amyl nitrate pearls are crushed and placed in the ventilator reservoir to induce methemoglobinemia. Cyanide has a 20% to 25% higher affinity for methemoglobin than it does for hemoglobin; it binds methemoglobin to form either cyanomethemoglobin or sulfmethemoglobin. The cyanomethemoglobin is then detoxified in the liver by the enzyme rhodanese. Next, IV sodium nitrite is given to induce the rapid formation of methemoglobin. IV sodium thiosulfate is then given; it has a higher affinity for cyanide than methemoglobin and stimulates the conversion of cyanide to sodium thiocyanate, which can be excreted by the kidneys (ENA, 2014); (Tintinalli, Stapczyski, Ma, et al., 2016). Although they may be lifesaving, these emergency medications do have side effects—sodium nitrite can result in severe hypotension, and thiocyanate can cause vomiting, psychosis, arthralgia, and myalgia.

The production of methemoglobin is contraindicated in patients with smoke inhalation, because they already have decreased oxygen-carrying capacity secondary to the carboxyhemoglobin produced by smoke inhalation. In facilities where a hyperbaric chamber is available, it may be used to provide oxygenation while the previously discussed therapies are initiated. An alternative suggested treatment for cyanide poisoning is hydroxocobalamin (vitamin B_{12a}). Hydroxocobalamin binds cyanide to form cyanocobalamin (vitamin B_{12}). It must be administered IV in large doses (Tintinalli et al., 2016). Administration of vitamin B_{12} can result in a transient pink discoloration of mucous membranes, skin, and urine. In high doses, tachycardia and hypertension can occur, but they usually resolve within 48 hours.

Pulmonary Agents

Pulmonary agents such as phosgene and chlorine destroy the pulmonary membrane that separates the alveolus from the capillary bed, disrupting alveolar–capillary oxygen transport mechanisms. Capillary leakage results in fluid-filled alveoli. Phosgene and chlorine both vaporize, rapidly causing this pulmonary injury. Phosgene has the odor of freshly mown hay.

Signs and symptoms include pulmonary edema with shortness of breath, especially during exertion. An initial hacking cough is followed by frothy sputum production. A particulate air filter mask is the only protection required to protect health care personnel. Phosgene does not injure the eyes. In a review of a chlorine spill in South Carolina that exposed 155 patients, the most useful tool for identifying worsening symptoms was the pulse oximeter. Ordinary triage systems did not predict the severity of exposure (Culley, Svendsen, Craig, et al., 2014).

Nuclear Radiation Exposure

The threat of nuclear warfare or exposure to a radiologic weapon is very real with the availability of nuclear material and easily concealed simple devices, such as the so-called dirty bomb, for dispersal. A dirty bomb is a conventional explosive (e.g., dynamite) that is packaged with radioactive material that scatters when the bomb is detonated. It disperses radioactive material and may be called a radiologic weapon, but it is not a *nuclear* weapon, which uses a complex nuclear fission reaction that is thousands of times more devastating than the dirty bomb.

Sources of radioactive material include not only nuclear weapons but also reactors and simple radioactive samples, such as weapons-grade plutonium or uranium, freshly spent nuclear fuel, or medical supplies (e.g., radium, certain cesium isotopes) used in cancer treatments and radiology. Exposure to a large number of people can be accomplished by placing a radioactive sample in a public place. Thousands may be exposed this way; some may be immediately affected, and others may require health monitoring for many years to assess long-term effects.

Any terrorist act or unintentional radiation release can be sizable and may require the entire hospital and prehospital staff to be prepared, recognize signs and symptoms of exposure, and rapidly treat victims without contamination of personnel, visitors, patients, or the facility itself.

Types of Radiation

Atoms consist of protons, neutrons, and electrons. The protons and neutrons are in balance in the nucleus. The protons repel

each other because they are all positively charged. The number of protons is specific for each element in the periodic table. There is a specific ratio of protons and neutrons for each different atom, and the result is element stability. When an element is radioactive, there is an imbalance in the nucleus, resulting from an excess of neutrons.

To achieve stability, a radioactive nuclide can eject particles until the most stable number (an even number) of protons and neutrons exists. A proton can become a neutron by ejecting a positron; conversely, a neutron can become a proton by ejecting a negative electron. An alpha particle is released when two protons and two electrons are ejected (beta particles are electrons).

Alpha particles cannot penetrate the skin. A thin layer of paper or clothing is all that is necessary to protect the skin from alpha radiation. However, this low-level radiation can enter the body through inhalation, ingestion, or injection (open wound). Only localized damage occurs.

Beta particles have the ability to moderately penetrate the skin to the layer in which skin cells are being produced. This high-energy radiation can cause skin damage if the skin is exposed for a prolonged period and can cause injury if beta particles penetrate the skin.

Gamma radiation is a short-wavelength electromagnetic energy that is emitted when there is excess core nucleus energy. Gamma particles are penetrating. Therefore, it is difficult to shield against gamma radiation. X-rays are an example of gamma radiation. Gamma radiation often accompanies both alpha particle and beta particle emission.

Measurement and Detection

Radiation is measured in several different units. The *rad* is the basic unit of measurement. A rad is equivalent to 0.01 J of energy per kilogram of tissue. To determine the damaging effect of the rad, a conversion to the *rem* (roentgen equivalents man) is necessary. The rem reflects the type of radiation absorbed and the potential for damage. For example, 200,000 mrem results in mild radiation sickness (1 rem = 1000 mrem) (ACS, 2010). Typical natural yearly exposure for a person is 360 mrem. Another important concept is *half-life*. The half-life of a radioactive product is the time it takes to lose half of its radioactivity.

The only way to detect radiation is through a device that determines the exposure per minute. There are various devices for this purpose. The Geiger counter (or Geiger-Mueller survey meter) can measure background radiation quickly through detection of gamma radiation and some beta radiation. With high-level radiation, the Geiger counter may underestimate exposure. Other devices include the ionization chamber survey meter, alpha monitors, and dose rate meters. Personal dosimeters are simple tools that identify radiation exposure and are worn by radiology personnel every day.

Exposure

Exposure is affected by time, distance, and shielding. The longer a person is within the radiation area, the higher the exposure. In addition, the larger the amount of radioactive material in the area, the greater the exposure. The farther away the person is from the radiation source, the lower the exposure. Shielding from the radiation source also decreases exposure.

Three types of radiation-induced injury can occur: external irradiation, contamination with radioactive materials, and incorporation of radioactive material into body cells, tissues, or organs:

- *External irradiation* exposure occurs when all or part of the body is exposed to radiation that penetrates or passes completely through the body. In this type of exposure, the person is not radioactive and does not require special isolation or decontamination measures. Irradiation does not necessarily constitute a medical emergency.
- *Contamination* occurs when the body is exposed to radioactive gases, liquids, or solids either externally or internally. If internal, the contaminant can be deposited within the body. Contamination requires immediate medical management to prevent incorporation.
- *Incorporation* is the actual uptake of radioactive material into the cells, tissues, and susceptible organs. The organs involved are usually the kidneys, bones, liver, and thyroid.

Sequelae of contamination and incorporation can occur days to years later. The thyroid gland can be largely protected from radiation exposure by administration of stable iodine (potassium iodide, or KI) before or promptly after the intake of radioactive iodine. Priorities in the treatment of any type of radiation exposure are always treatment for life-threatening injuries and illnesses first, followed by measures to limit exposure, contamination control, and finally decontamination.

Decontamination

Hospital and community disaster plans should be in effect when managing a radiation disaster. Access restriction is essential to prevent contamination of other areas of the hospital. Triage outside the hospital is the most effective means of preventing contamination of the facility itself. Floors are covered to prevent tracking of contaminants throughout the treatment areas. Strict isolation precautions should be in effect. All air ducts and vents must be sealed to prevent spread. Waste is controlled through double-bagging and the use of plastic-lined containers outside of the facility. All radiation-contaminated waste must be disposed in appropriate color-coded yellow and magenta canisters.

Staff are required to wear protective clothing, such as water-resistant gowns, two pairs of gloves, masks, caps, goggles, and booties. Dosimetry devices should be worn by all staff members participating in patient care. The radiation safety officer in the hospital should be notified immediately to assist with surveys (using a radiation survey meter) of the incoming patients and to provide dosimeters to all staff personnel involved in direct care of patients who have been exposed. There is minimal risk to staff if the patients are properly surveyed and decontaminated.

Each patient arriving at the hospital should first be surveyed with the radiation survey meter for external contamination and then directed toward the decontamination area as needed. The majority of patients can be safely decontaminated with soap and water. Decontamination occurs outside of the ED with a shower, collection pool, tarp, and collection containers for patient belongings, as well as soap, towels, and disposable paper gowns for patients. Water runoff needs to be contained. Patients who are uninjured can perform self-decontamination with handheld showers. After the patient has showered, a resurvey is conducted to determine whether the radioactive contaminants have been removed. Additional washings should occur until the patient is free of contamination. It is important to ensure that during showers, previously clean areas are not contaminated with runoff from the washed contaminated areas (e.g., hair should be washed in a position that protects the body from

contamination). Wounds are irrigated and then covered with a water-resistant dressing prior to total body decontamination.

Internal contamination or incorporation requires decontamination through catharsis, gastric lavage with chelating agents (agents that bind with radioactive substances and are then excreted), or both. Samples of urine, feces, and vomitus are surveyed to determine internal contamination levels. Biologic samples are taken through nasal and throat swabs, and a complete blood count with differential is obtained.

Acute Radiation Syndrome

Acute radiation syndrome (ARS) can occur after exposure to radiation. It is the dose, rather than the source, that determines whether ARS develops. Factors that determine whether the patient's response to exposure will result in ARS include a high dose (minimum 100 rad) and rate of radiation with total body exposure and penetrating-type radiation. Age, medical history, and genetics also affect the outcome after exposure. The course is predictable. Table 61-7 identifies the phases of ARS.

Each body system is affected differently in ARS. Systems with cells that rapidly reproduce are most commonly affected. The hematopoietic system is the first system affected and serves as an indicator of the severity of radiation exposure (Veenema, 2013). A predictor of outcome is the absolute lymphocyte count at 48 hours after exposure. A significant exposure would be indicated by blood lymphocyte counts of 300 to 1200/mm^3. Barrier precautions should be implemented to protect the patient from infection. Neutrophils decrease within 1 week, platelets decrease within 2 weeks, and red blood cells decrease within 3 weeks. Hemorrhagic complications including fever and sepsis are common.

The gastrointestinal system, with its rapidly reproducing cells, is also readily affected by radiation. Doses of radiation required to produce symptoms are approximately 600 rad or higher. The gastrointestinal symptoms usually occur at the same time as the changes in the hematopoietic system. Nausea and vomiting occur within 2 hours after exposure. Sepsis, fluid and electrolyte imbalance, and opportunistic infections can occur as complications. An ominous sign is the presence of high fever and bloody diarrhea; these typically appear on day 10 after exposure (ENA, 2014).

The central nervous system is affected when the dose exceeds 1000 rad (ENA, 2014). The symptoms occur when damage to the blood vessels of the brain results in fluid leakage. Signs and symptoms include cerebral edema; nausea; vomiting; headache; and increased intracranial pressure, which heralds a poor outcome and imminent death. Central nervous system injury with this amount of exposure is irreversible and occurs before hematopoietic or gastrointestinal system symptoms appear. Cardiovascular collapse is usually seen in conjunction with these injuries.

Skin effects can also indicate the dose of radiation exposure. With exposure of 600 to 1000 rad, erythema occurs; it can disappear within hours and then reappear. The patient who has been exposed must be evaluated hourly for the presence of erythema. With exposures greater than 1000 rad, desquamation (radiation dermatitis) of the skin occurs. Necrosis becomes evident within a few days to months at doses greater than 5000 rad.

Secondary injury can occur when the radiation exposure occurs during a traumatic event such as a blast or burn. Trauma in addition to radiation exposure increases patient mortality. Attention must first be directed toward the primary assessment for trauma. Airway, breathing, circulation, and fracture reduction require immediate attention. All definitive treatments must occur within the first 48 hours. Thereafter, all surgical procedures should be delayed for 2 to 3 months because of the potential for delayed wound healing and the possible development of opportunistic infections several weeks after exposure.

TABLE 61-7 Phases of Effects of Radiation Exposure

Phase	Time of Occurrence	Signs and Symptoms
Prodromal phase (presenting symptoms)	48–72 hours after exposure	Nausea, vomiting, loss of appetite, diarrhea, fatigue High-dose radiation—fever, respiratory distress, and increased excitability
Latent phase (a symptom-free period)	After resolution of prodromal phase; can last up to 3 weeks With high-dose radiation, latent period is shorter	Decreasing lymphocytes, leukocytes, thrombocytes, red blood cells
Manifest illness phase	After latent period phase	Infection, fluid and electrolyte imbalance, bleeding, diarrhea, shock, and altered level of consciousness
Recovery phase	After manifest illness phase	Can take weeks to months for full recovery
Death	After manifest illness phase	Increased intracranial pressure is a sign of impending death

Adapted from Centers for Disease Control and Prevention (CDC). (2015). *Acute radiation syndrome: A fact sheet for clinicians*. Retrieved on 11/26/2016 at: www.emergency.cdc.gov/radiation/arsphysicianfactsheet.asp

Survival

There are three categories of predicted survival after radiation exposure: probable, possible, and improbable. Triage of victims at the scene, after decontamination, is conducted using the routine system for disaster triage. Presenting signs and symptoms determine the potential for survival and therefore the category of predicted survival during triage.

Probable survivors have either no initial symptoms or only minimal symptoms (e.g., nausea and vomiting), or these symptoms resolve within a few hours. These patients should have a complete blood count drawn and may be discharged with instructions to return if any symptoms recur.

Possible survivors present with nausea and vomiting that persist for 24 to 48 hours. They experience a latent period, during which leukopenia, thrombocytopenia, and lymphocytopenia occur. Barrier precautions and protective isolation are implemented if the patient's lymphocyte count is less than 1200/mm^3. Supportive treatment includes administration of blood products, prevention of infection, and provision of enhanced nutrition.

Improbable survivors have received more than 800 rad of total-body penetrating irradiation. People in this group demonstrate an acute onset of vomiting, bloody diarrhea, and shock. Any neurologic symptoms suggest a lethal dose of radiation (ENA, 2014). These patients still require decontamination to prevent further contamination of the area and of others. Personal protection is essential, because it is virtually impossible to fully decontaminate these patients; all of their internal organs have

been irradiated. The survival time is variable; however, death usually occurs swiftly due to shock. If there are no neurologic symptoms, patients may be alert and oriented, similar to a patient with extensive burns. In a mass casualty situation, these patients would be triaged into the black category, where they will receive comfort measures and emotional support. If it is not a mass casualty situation, aggressive fluid and electrolyte therapies are essential.

Legal Issues in Disaster Management

Legal and ethical guidelines are essential for effective disaster management. Law plays a major role in protecting the vulnerable population and to ensure equitable relief for all those affected by disaster. Integration of legal and ethical guidelines in all the phases of disaster cycle is essential for seamless disaster response. Legal guidelines aid in the disaster recovery process. The Indian Disaster Management Act provides clear-cut guidelines for the disaster relief work. This Act delineates and has streamlined the responsibility from the central government, state government, district, and local bodies so that relief work flows in an orderly fashion.

In times of disaster, many international and national agencies, NGOs, churches, and other agencies come forward to provide relief work. The aids need to be provided without any discrimination to the affected families and persons. The disaster relief materials need to be provided without seeking political or religious affiliations and without interfering in the internal matters of the country.

The government needs to ensure that aid is not used to collect sensitive information about the state or country which is not necessary for disaster recovery. The aid should be provided in coordination with the local body legally permitted to provide relief work by the state and central governments. The relief workers who have volunteered to provide specialized services like that of anesthesiologist, surgeon, nurse, etc., need to have the license certificate from the respective councils as legal credentials for their work. The relief worker if found to be causing injury or harm due to negligence is liable for punishment (Dalal & Krishnamoorthy, 2018). The nurses and other health care professionals involved in relief work are expected to follow the ethical code of conduct. They are expected to provide relief works without discriminating the victims on the basis of economic, social, religious, or linguistic barriers.

Ethical Issues in Disaster

Disasters can present a disparity between the resources of the health care agency and the needs of the victims. This generates ethical dilemmas for nurses and other health care providers. Issues include conflicts related to the following:

- Assisted suicide
- Confidentiality
- Consent
- Duty
- Futile therapy
- Rationing care
- Resuscitation

Nurses may find it difficult not to provide care to the dying or to withhold information to avoid spreading fear and panic. Vulnerable populations, especially the children, pregnant women, and elderly, are given priority in rescue operations, whereas everyone deserves quick relief from crisis. Children may get separated from parents and may be exploited in the disaster scenario. As nurses, we need to ensure that the vulnerable population needs to be safeguarded. Clinical scenarios that are unimaginable in normal circumstances confront the nurse in extreme instances. Other ethical dilemmas may arise out of health care providers' instincts for self-protection and protection of their families (ANA, 2010). For example, what should a nurse who is pregnant do when incoming disaster victims have been exposed to radiation yet too few nurses are available?

Nurses can plan for the ethical dilemmas they will face during disasters by establishing a framework for evaluating ethical questions before they arise and by identifying and exploring possible responses to difficult clinical situations. They can consider how the fundamental ethical principles of nonmaleficence, beneficence, and distributive justice will influence their decisions and care in disaster response.

CRITICAL THINKING EXERCISES

1. You work in an occupational health clinic that provides support to a chemical plant that manufactures chlorine. A patient walks to the clinic after being told to report for an examination by his supervisor since he temporarily removed his PPE while at work. Although he walked to the clinic, he tells you that now his eyes are burning and he is experiencing blurry vision. What evidence-based assessments and interventions would you now implement and why?
2. You are a home health nurse. Several patients who comprise your caseload are dependent upon electronic medical equipment, including one patient who requires home mechanical ventilation and three who require home intravenous therapy. You live in a coastal area and a category 4 hurricane is threatening to hit your community within the next 48 hours. Describe the precautions you would take to ensure that these patients are not deprived of the use of their electronic medical equipment in case of a loss of power.
3. You are working in the emergency department (ED) of a community hospital. One evening, a radio call from EMS sends an alert that there is a possible multiple shooting at a restaurant a block away from the hospital. What are your priorities and first actions? What might be done to ensure safety of the ED staff and patients? How would you prepare for the arrival of patients who may have been injured from this event?

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

American College of Surgeons (ACS). (2010). Disaster management and emergency preparedness course. Chicago: Author.

American College of Surgeons Committee on Trauma (ACS-COT). (2014). Resources for optimal care of the injured patient. Chicago: Author.

Auerbach, P. S. (2017). Wilderness medicine (6th ed.). Philadelphia, PA: Mosby Elsevier.

Emergency Nurses Association (ENA). (2013). Sheehy's manual of emergency care (7th ed.). St. Louis, MO: Elsevier Mosby.

Emergency Nurses Association (ENA). (2014). Trauma nursing core course (7th ed). Chicago: Emergency Nurses Association.

Guidelines for hospital emergency preparedness planning GOI -UNDP –DRM program (2008) retrieved on 7/17/2018 at http://asdma.gov.in/pdf/publication/undp/guidelines_hospital_emergency.pdf

National Disaster Management Plan. (2016). Retrieved on 07/17/2018 at https://ndma.gov.in/images/policyplan/dmplan/National%20Disaster%20Management%20Plan%20May%202016.pdf

National Policy on Disaster Management, Government of India, Ministry of Home Affairs. (2009) Retrieved on 7/17/2018 at https://ndma.gov.in/images/guidelines/national-dm-policy2009.pdf
Tintinalli, J. E., Stapczyski, J. S., Ma, O. J., et al. (2016). Tintinalli's emergency medicine manual (8th ed.). New York: McGraw-Hill Medical.
Veenema, T. G. (2013). Disaster nursing and emergency preparedness (3rd ed.). New York: Springer.

Journals and Electronic Documents

Abbasi, J. (2016). Expanding the health care response to mass violence. JAMA, 316(10), 1031–1033.
Agency for Toxic Substances and Disease Registry. (2016). *HazMat emergency preparedness training and tools for responders*. Retrieved on 11/26/2016 at: www.atsdr.cdc.gov/hazmat-emergency-preparedness.html
American Nurses Association. (2010). Who will be there? Ethics, the law, and a nurse's duty to respond in a disaster. ANA Issue Brief. Retrieved on 3/27/2017 at: www.nursingworld.org/MainMenuCategories/WorkplaceSafety/Healthy-Work-Environment/DPR/Disaster-Preparedness.pdf
Centers for Disease Control and Prevention (CDC). (2012). *Blast injuries: Fact sheets for professionals*. Retrieved on 3/25/2017 at: stacks.cdc.gov/view/cdc/21571/Print
Centers for Disease Control and Prevention (CDC). (2016). *Smallpox: Who should get vaccination*. Retrieved on 3/23/2017 at: www.cdc.gov/smallpox/vaccine-basics/who-gets-vaccination.html
Ciottone, G. R., & Arnold, J. L. (2015). CBRNE—Chemical warfare agents. Medscape. Retrieved on 11/26/2015 at: emedicine.medscape.com/article/829454-overview
Costa-Roberts, D. (2015). 4 surprising facts from the 2015 Global Terrorism Index. PBS Newshour. Retrieved on 3/25/2017 at: www.pbs.org/newshour/rundown/4-surprising-facts-from-the-2015-global-terrorism-index/
Culley, J. M., Svendsen, E., Craig, J., et al. (2014). A validation study of 5 triage systems using data from the 2005 Graniteville South Carolina chlorine spill. Journal of Emergency Nursing, 40(5), 453–460.
Dire, D. J. (2016). CBRNE—Biological warfare agents. Medscape. Retrieved on 11/26/2016 at: emedicine.medscape.com/article/829613-overview
Dodd-Murphy, J. (2014). Auditory effects of blast exposure: Community outreach following an industrial explosion. American Speech Language Hearing Association. Retrieved on 3/25/2017 at: www.asha.org/Articles/Auditory-Effects-of-Blast-Exposure/
Nadworny, D., Davis, K., Miers, C., et al. (2014). Boston strong—one hospital's response to the 2013 Boston marathon bombings. Journal of Emergency Nursing, 40(5), 418–427.
Pennardt, A., & Lavonas, E. J. (2016). Blast injuries. Medscape. Retrieved on 4/2/2017 at: emedicine.medscape.com/article/822587-overview
Dalal, S., & Krishnamoorthy, C. (2018). Legal considerations during disasters in India. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 17(12), 67–73.
**U.S. Department of Homeland Security Federal Emergency Management Agency (FEMA) & the American Red Cross. (2004). *Preparing for disaster for people with disabilities and other special needs*. Retrieved on 11/26/2016 at: www.redcross.org/images/MEDIA_CustomProductCatalog/m4240199_A4497.pdf
U.S. Department of Homeland Security National Terrorism Advisory System (NTAS). (2015). *NTAS frequently asked questions*. Retrieved on 4/2/2017 at: www.dhs.gov/ntas-frequently-asked-questions
Valdez, A. M. (2015). Are you covered? Safe practices for the use of personal protective equipment. Journal of Emergency Nursing, 41(2), 154–157.
**World Health Organization. (2005). *Disasters, disability and rehabilitation*. Retrieved on 11/26/2016 at: www.who.int/violence_injury_prevention/other_injury/disaster_disability2.pdf
*Zidek, C., West, E., Holmes, J., et al. (2014). A survey comparison of rural versus urban residents and household preparedness. Home Healthcare Nurse, 32(7), 420–429.

Resources

Agency for Toxic Substances and Disease Registry, www.atsdr.cdc.gov
American Red Cross, Beat Disaster with Preparedness, www.redcross.org/news/article/Beat-Disaster-with-Preparedness
Centers for Disease Control and Prevention (CDC), Emergency Preparedness and Response, www.emergency.cdc.gov
Chemtrac, www.chemtracglobal.com
Emergency Management Research Institute (EMRI), http://www.emri.in/
Global terrorism database, www.start.umd.edu/gtd
Indian Red Cross Society, www.indianredcross.org
National Civil Defence College, http://www.cddrm-ncdc.org
National Disaster Management Authority, https://ndma.gov.in
National Organization on Disability, www.nod.org
St. John's Ambulance India, http://stjohnambulance.in/
U.S. Department of Homeland Security, www.dhs.gov

UNIT

XX

Care of Elderly

Chapter 62 Health Care of the Older Adult 2035

CHAPTER 62

Health Care of the Older Adult

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Specify the demographic trends and the physiologic aspects of aging in India.
2. Describe the significance of preventive health care and health promotion for the older adult.
3. Compare and contrast the common physical and mental health problems of aging and their effects on the functioning of older adults and their families.
4. Identify the role of the nurse in meeting the health care needs of the older patient.
5. Describe the services provided for the elderly under the National Programme for Health Care of the Elderly.
6. Examine common health issues of older adults and their families in the home and the community, in the acute care setting, and in the long-term care facility.

GLOSSARY

activities of daily living (ADLs): personal care activities such as bathing, dressing, grooming, eating, toileting, and transferring
ageism: a bias that discriminates, stigmatizes, and disadvantages older adults based solely on their chronologic age
comorbidity: having more than one illness at the same time (e.g., diabetes and congestive heart failure)
delirium: an acute, confused state that begins with disorientation and if not recognized and treated early can progress to changes in level of consciousness, irreversible brain damage, and sometimes death
dementia: broad term for a syndrome characterized by a general decline in higher brain functioning, such as reasoning, with a pattern of eventual decline in the ability to perform even basic activities of daily living, such as toileting and eating
depression: the most common affective (mood) disorder of old age; results from changes in reuptake of the neurochemical serotonin in response to chronic illness and emotional stresses
durable power of attorney: a formal, legally endorsed document that identifies a proxy decision maker who can make decisions if the signer becomes incapacitated
elder abuse: the physical, emotional, or financial harm to an older person by one or more of the individual's children, caregivers, or others; includes neglect
geriatric syndromes: common conditions found in older adults that tend to be multifactorial and do not fall under discrete disease categories; these conditions include falls, delirium, frailty, dizziness, and urinary incontinence
geriatrics: a field of practice that focuses on the physiology, pathology, diagnosis, and management of the disorders and diseases of older adults
gerontologic/geriatric nursing: the field of nursing that relates to the assessment, planning, implementation, and evaluation of older adults in all environments, including acute, intermediate, and skilled care, as well as within the community
gerontology: the combined biologic, psychological, and sociologic study of older adults within their environment
instrumental activities of daily living (IADLs): complex skills needed for independent living, such as shopping, cooking, housework, using the telephone, managing medications and finances, and being able to travel by car or public transportation
orientation: a person's ability to recognize who and where he or she is in a time continuum; used to evaluate one's basic cognitive status
polypharmacy: the use of multiple medications
presbycusis: the decreased ability to hear high-pitched tones that naturally begins in midlife as a result of irreversible inner ear changes
presbyopia: the decrease in visual accommodation that occurs with advancing age
urinary incontinence: the unplanned loss of urine

Introduction

Aging, the normal process of time-related change, begins with birth and continues throughout life. Average life expectancy of an Indian was only 53 years in 1978, which has increased to 59 years after the period of 40 years, and geriatric population is rapidly expanding in India. Whenever nurses work with adults, they are likely to encounter older adult patients. This chapter presents demographics of aging, normal age-related changes, health problems associated with aging, and ways that nurses can address the health issues of older adults.

Overview of Aging

Demographics of Aging

The proportion of Indians 60 years of age and older has significantly increased in last few decades because of ever increasing life expectancy of people in the country. As the older adult population increases, the number of people who live to a very old age is also dramatically increasing. Life expectancy has risen dramatically in the past 100 years. In 1900, average life expectancy was 58 years, and by 2017, that figure had increased to 69.6 years. The older adult population is becoming more

diverse, reflecting changing demographics in India. Presently, in India, 8.6% (103.9 million people) population is elderly; furthermore, 8.8% of the rural population is elderly and 8.1% of the urban dwellers are elderly (Ministry of Statistics and Programme Implementation, 2016).

Health Status of the Older Adult

Although many older adults enjoy good health, most have at least one chronic illness, and many have multiple health conditions. Chronic conditions, many of which are preventable or treatable, are the major cause of disability and pain among older adults (see Fig. 62-1).

Many chronic conditions commonly found among older people can be managed, limited, and even prevented. Older people are more likely to maintain good health and functional independence if encouraged to do so and if appropriate community-based support services are available (Miller, 2015). Nurses are challenged to promote positive lifelong health behaviors, because the impact of unhealthy behaviors and choices can result in chronic disease.

Nursing Care of the Older Adult

Gerontology, the study of the aging process, is a multidisciplinary field that draws from the biologic, psychological, and sociologic sciences. Geriatrics is the practice (medical or nursing) that focuses on the physiology, pathology, diagnosis, and management of the disorders and diseases of older adults. Care for older adults should not be limited to one discipline but is best provided through a cooperative effort. An interdisciplinary approach to providing care combines expertise and resources to provide comprehensive geriatric assessment and intervention. Nurses collaborate with the team to obtain appropriate services for patients and provide a holistic approach to care.

Gerontologic/geriatric nursing is the field of nursing that specializes in the care of older adults. The Scope and Standards of Gerontological Nursing Practice was originally developed in 1969 by the American Nurses Association (ANA) and revised in 2010 (ANA, 2010). The nurse gerontologist can be either a specialist or a generalist providing comprehensive nursing care to older adults by combining the basic nursing process with a specialized knowledge of aging. Gerontologic nursing is provided in acute care, skilled and assisted living, the community, and home settings. The goals of care include promoting and maintaining functional status as well as helping older adults identify and use their strengths to achieve optimal independence.

Nurses who are certified in geriatric nursing have specialized knowledge of the acute and chronic changes specific to older adults. The use of advanced practice nurses who have been educated in geriatric nursing concepts has proved to be very effective when dealing with the complex care needs of an older patient. When best practices are used and current scientific knowledge applied to clinical problems, there is significantly less deterioration in the overall health of aging patients (ANA, 2010).

In addition to specialists, nurses who work in all areas of adult medical-surgical nursing encounter older adult patients. Nurses must be knowledgeable and skilled in meeting the complex needs of these patients. Nurses and caregivers who work with older patients must understand that aging is not synonymous with disease and that the effects of the aging process alone are not the only or even the primary contributors to disability and disease. Aging is a highly individualized and multifaceted process (Cline, 2014).

Functional assessment is a common framework for assessing older adults. Age-related changes, as well as additional risk factors such as disease and the effects of medications, can

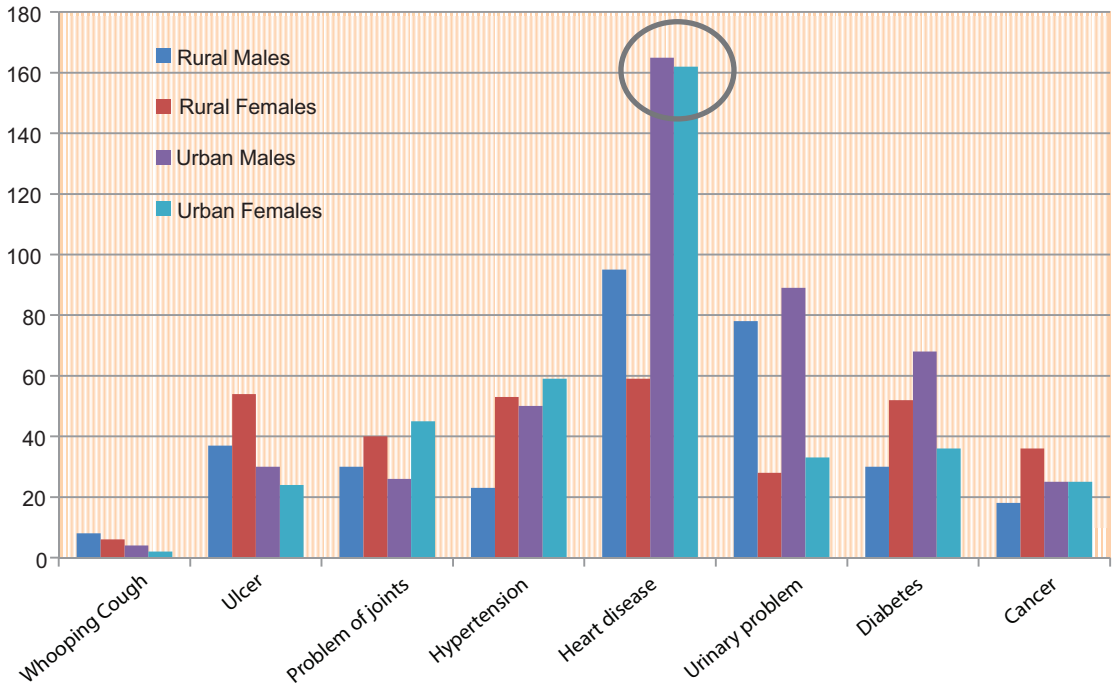


Figure 62-1 • Number of elderly persons reporting a chronic disease (per 1,000 persons). Source: Ministry of Statistics & Programme Implementation (2011). Situation analysis of the elderly in India. Retrieved at: http://mospi.nic.in/sites/default/files/publication_reports/ElderlyinIndia_2016.pdf.

reduce function. Assessing the functional consequences of aging and proposing practical interventions help maintain and improve the health of older adults. The goal is to help older adults sustain maximum functional level and dignity despite physical, social, and psychological losses. Early intervention can prevent complications of many health problems and help maximize the quality of life.

Theories of Aging

Aging has been defined chronologically by the passing of time—subjectively, as in how a person feels, and functionally, as in changes in physical or mental capabilities. Many theories attempt to provide a framework in which to understand aging from different perspectives. Clinicians can use each theory to gain insight into different aspects of aging.

Biological Theories of Aging

The biological theories of aging are focusing on the functional changes that occur over time in various systems of the human body. They are divided into two:

Stochastic Theories

These theories presume that events related to aging occur over time. There are four theories under this category (Jin, 2010):

- **Error theory:** This theory proposes that the error in DNA synthesis is perpetuated and leads to decline in function in the elderly.
- **Free radical theory:** During the metabolism, free radicals emerge and get accumulated. Accumulated free radicals damage the cell membranes and thereby reduce the functional efficacy of the cells and systems leading to aging. The body tries to limit its antioxidant secretion which removes the free radicals.
- **Cross-linkage theory:** According to this theory, some proteins get cross-linked which results in accumulation of waste substances and poor functional ability of the cells.
- **Wear and tear theory:** According to this theory, the human body is a machine. As machine undergoes wear and tear, the cells and system of the body also become insufficient and decline in function.

Nonstochastic Theories

These theories presume aging as a certain predetermined, timed phenomenon. There are two theories under this category (Jin, 2010):

- **Programmed theory:** As per this theory, the cells are programmed so that they replicate only a limited number of times. After a certain number of cell divisions, the cells stop dividing.
- **Immunity theory:** The immune system of our body, especially the T lymphocytes, undergoes lot of changes which lead to irreversible damage.

Sociological Theories

- **Disengagement theory:** This theory proposes that as a person withdraws himself or herself from the society, the society in turn disengages with him or her, leading to age-related functional decline.
- **Activity theory or developmental task theory:** This theory proposes that one needs to keep oneself active to remain healthy and to have a positive self-concept. By being active, an older person can retain a positive self-concept and stay healthy.
- **Continuity theory:** Old age is viewed as the continuation of the earlier phase of life and not as the terminal phase. Individuals continue to remain to have some habits and activities in the same way as earlier.
- **Age stratification theory:** The society is stratified according to age and roles and an individual progresses through the society in groups or cohorts.
- **Environment fit theory:** Each individual has the competency to function effectively within the environment. As the person gets aged, he or she may feel threatened and become incompetent, leading to withdrawal from the society.

Psychological Theories of Aging

The basic assumption of psychological theories of aging is that the development of an individual through middle age to old age is a continuous and dynamic process.

- **Maslow's hierarchy of needs:** According to Maslow, there are five needs, with basic human needs at the bottom of the pyramid followed by safety and security, love and belonging, self-esteem, and self-actualization. Each individual will have his or her internal priority which motivates him or her to reach the next level of achievement.
- **Jung's theory of individualism:** According to Jung, aging is not just associated with decline of the body and mind strength and relevancy but also a time to grow one's own self-awareness. Jung considers that refinement of self-awareness and self-knowledge is the essence of aging.
- **Ericson's psychosocial development theory:** According to Eric Ericson, an individual passes through eight stages of development. Each stage of life development presents a crisis. If the individual gets mastery of the corresponding task, he or she moves smoothly to the next stage. The last phase of development is marked by ego integrity versus despair. If the task of this stage is not mastered, it leads to desperation.
- **Selective optimization with compensation:** The physical strength reduces with age. To compensate for this loss, an individual can adapt through selection, optimization, and compensation.

In addition to the biologic, developmental, and sociologic theories of aging, Miller (2015) developed the Functional Consequences Theory, which encourages nurses to consider the effects of normal age-related changes as well as the damage incurred through disease or environmental and behavioral risk factors when planning care. This theory suggests that nurses can alter the outcome for patients through nursing interventions that address the consequences of these changes. Age-related changes and risk factors may negatively interfere with patient outcomes and impair patient activity and quality of life. For example, normal age-related changes in vision may increase sensitivity to glare. Alterations in the environment that reduce glare may enhance patient comfort and safety. In contrast, the development of cataracts, which is not a normal age-related change, also may increase sensitivity to glare. The nurse must differentiate between normal, irreversible age-related changes and modifiable risk factors. Doing so helps the nurse design appropriate nursing interventions that have a positive impact on outcomes for older patients—most importantly, for their quality of life.

Age-Related Changes

The well-being of older adults depends on physical, psychosocial, mental, social, economic, and environmental factors. A total

assessment includes an evaluation of all major body systems, social and mental status, and the person's ability to function independently (Weber & Kelley, 2014).

Physical Aspects of Aging

Intrinsic aging (from within the person) refers to those changes caused by the normal aging process that are genetically programmed and essentially universal within a species. Universality is the major criterion used to distinguish normal aging from pathologic changes associated with illness. However, people age quite differently and at different rates; thus, chronologic age is often less predictive of obvious age characteristics than other factors, such as one's genetics (see Chart 62-1) and lifestyle.

Cellular and extracellular changes that occur with aging cause functional decline and measurable changes in physical appearance, including changes in shape and body makeup. Cellular aging and tissue deficits also diminish the body's ability to maintain homeostasis and prevent organ systems from functioning at full efficiency. As cells become less able to replace themselves, they accumulate a pigment known as lipofuscin. A degradation of elastin and collagen causes connective tissue to become stiffer and less elastic. These changes result in diminished capacity for organ function and increased vulnerability to disease and stress. Age-related changes in the hematopoietic system influence red blood cell production, leading to increased rates of anemia (Grossman & Porth, 2014).

Table 62-1 summarizes subjective and objective findings related to age-related changes in the body systems. More in-depth information about age-related changes can be found in the chapters pertaining to each organ system.

When assessing the physical aspects of aging, nurses should know that tactile sensation is reduced and changes in the ability to sense pressure, pain, and temperature all lead to a decreased ability to identify and attend to physical symptoms (Oster & Oster, 2015).

Cardiovascular System

Heart disease is the leading cause of death in older adults. Age-related changes reduce the efficiency of the heart and contribute to decreased compliance of the heart muscle. These changes include myocardial hypertrophy, which changes left ventricular strength and function; increased fibrosis and calcified tissues that infiltrate muscles and conductive tissues causing stenosis of the valves; and decreased pacemaker cells. As a result, the heart valves become thicker and stiffer, and the heart muscle and arteries lose their elasticity, resulting in a reduced stroke volume. Calcium and fat deposits accumulate within arterial walls, and veins become increasingly stiff and tortuous, increasing arterial resistance; this leads to hypertension and increases the workload of the heart (Capriotti & Frizzell, 2015).

It is difficult to differentiate between age- and disease-related changes in cardiovascular function because of the significant influence of behavioral factors on cardiovascular health. When cross-cultural studies are conducted, cardiovascular

Chart 62-1 GENETICS IN NURSING PRACTICE

Genetics Concepts and the Older Adult

Genetic conditions in the older adult may occur from a specific gene mutation or arise as a result of a genetic predisposition combined with other factors (multifactorial). The following are examples of some adult-onset genetic conditions:

- Colon cancer
- Hemochromatosis
- Huntington disease
- Polycystic kidney disease
- Alzheimer disease

The following are some examples of diseases with multifactorial components, which may include a genetic predisposition, in the older adult:

- Diabetes
- Emphysema
- Heart disease

Nursing Assessments

Refer to Chart 3-2: Genetics in Nursing Practice: Genetic Aspects of Health Assessment

Family History Assessment Specific to the Older Adult

- Collect and assess family history on both maternal and paternal sides of the family for three generations.
- Determine whether genetic testing has occurred with other family members.
- Assess for individual and family perceptions and beliefs around topics related to genetics.

Patient Assessment Specific to the Older Adult and Genetic Illness

- Assess older adult patient's knowledge and understanding of genetics, genetic testing, and gene-based therapies.
- Assess the patient's understanding of genetic information and decipher health literacy needs.
- Perform cultural, social, and spiritual assessment.
- Assess patient's communication capacities so that communication strategies about genetics are tailored to their needs and abilities.
- Identify patient's support system.

Management Issues Specific to Genetics and the Older Adult

- Refer for further genetic counseling and evaluation as warranted so that family members can discuss inheritance, risk to other family members, and availability of genetic testing and gene-based interventions.
- Offer appropriate genetic information and resources that take into consideration older patient's literacy needs.
- Evaluate older patient's understanding before, during, and after the introduction of genetic information and services.
- Take the time to clearly explain the concepts of genetic testing to older patients and provide written information that reinforces the topic of discussion.
- Participate in the management and coordination of care of older patients with genetic conditions and individuals predisposed to develop or pass on a genetic condition.

Genetics Resources

U.S. Department of Health and Human Services: provides information about health literacy and older adults, www.health.gov/communication/literacy/olderadults/literacy.htm

TABLE 62-1 Age-Related Changes in Body Systems and Health Promotion Strategies

Changes	Subjective and Objective Findings	Health Promotion Strategies
Cardiovascular System		
Decreased cardiac output; diminished ability to respond to stress; heart rate and stroke volume do not increase with maximum demand; slower heart recovery rate; increased blood pressure	Complaints of fatigue with increased activity Increased heart rate recovery time *Optimal blood pressure:* ≤120/80 mm Hg *Prehypertension:* >120–139/80–89 mm Hg *Hypertension:* ≥140/90 mm Hg	Exercise regularly; pace activities; avoid smoking; eat a low-fat, low-salt diet; participate in stress-reduction activities; check blood pressure regularly; adherence to medications; weight control (body mass index <25 kg/m^2).
Respiratory System		
Increase in residual lung volume; decrease in muscle strength, endurance, and vital capacity; decreased gas exchange and diffusing capacity; decreased cough efficiency	Fatigue and breathlessness with sustained activity; decreased respiratory excursion and chest/lung expansion with less effective exhalation; difficulty coughing up secretions	Exercise regularly; avoid smoking; take adequate fluids to liquefy secretions; receive yearly influenza immunization and pneumonia vaccine at 65 years of age; avoid exposure to upper respiratory tract infections.
Integumentary System		
Decreased subcutaneous fat, interstitial fluid, muscle tone, glandular activity, and sensory receptors, resulting in atrophy and decreased protection against trauma, sun exposure, and temperature extremes; diminished secretion of natural oils and perspiration; capillary fragility	Thin, wrinkled, and dry skin; increased fragility, more easily bruised, and sunburned; complaints of intolerance to heat; prominent bone structure	Limit sun exposure to 10–15 minutes daily for vitamin D (use protective clothing and sunscreen); dress appropriately for temperature; stay hydrated; maintain a safe indoor temperature; take shower rather than hot tub bath if possible; lubricate skin with lotions that contain petroleum or mineral oil.
Reproductive System		
Female: Vaginal narrowing and decreased elasticity; decreased vaginal secretions *Male:* Gradual decline in fertility, less firm testes, and decreased sperm production *Male and female:* Slower sexual response	*Female:* Painful intercourse; vaginal bleeding following intercourse; vaginal itching and irritation; delayed orgasm *Male:* Less firm erection and delayed erection and achievement of orgasm	*Female:* May require vaginal estrogen replacement; gynecology/urology follow-up; use a lubricant with sexual intercourse.
Musculoskeletal System		
Loss of bone density; loss of muscle strength and size; degenerated joint cartilage	Height loss; prone to fractures; kyphosis; back pain; loss of strength, flexibility, and endurance; joint pain	Weight-bearing exercise regularly (3 times a week); recommend bone density screening; take calcium and vitamin D supplements as prescribed.
Genitourinary System		
Decrease in detrusor muscle contractility, bladder capacity, flow rate, ability to withhold voiding; increase in residual urine *Male:* Benign prostatic hyperplasia *Female:* Relaxed perineal muscles; detrusor instability leads to urge incontinence; urethral dysfunction (stress urinary incontinence)	Urinary retention; irritative voiding symptoms including frequency, feeling of incomplete bladder emptying, multiple nighttime voiding Urgency/frequency syndrome; decreased "warning time"; drops of urine lost with cough, laugh, position change	Drink adequate fluids but limit drinking in evening; avoid bladder irritants (e.g., caffeinated beverages, alcohol, artificial sweeteners); do not wait long periods between voiding; empty bladder completely when voiding; wear easily manipulated clothing; consider urologic workup. Women: perform pelvic floor muscle exercises, preferably learned via biofeedback
Gastrointestinal System		
Decreased sense of thirst, smell, and taste; decreased salivation; difficulty swallowing food; delayed esophageal and gastric emptying; reduced gastrointestinal motility	Risk of dehydration, electrolyte imbalances, and poor nutritional intake; complaints of dry mouth; complaints of fullness, heartburn, and indigestion; constipation, flatulence, and abdominal discomfort; risk for aspiration	Use ice chips, mouthwash; brush, floss, and massage gums daily; receive regular dental care; eat small, frequent meals; sit up while and after eating and avoid heavy activity after eating; limit antacids; eat a high-fiber, low-fat diet; limit laxatives; toilet regularly; drink adequate fluids.
Nervous System		
Decrease in brain volume and cerebral blood flow. Reduced speed in nerve conduction	Slower to respond and react; learning may take longer; increased vulnerability to delirium with illness, anesthesia, even changes in environmental cues such as a room change; increased risk of fainting and falls	Pace teaching; with hospitalization, encourage visitors; enhance sensory stimulation; with sudden confusion, look for cause; encourage slow rising from a resting position and practice fall prevention measures

(Continued)

(Continued)

Special Senses		
Vision: Presbyopia; diminished ability to focus on close objects; decreased ability to tolerate glare; pupils become more rigid and lenses more opaque; decreased contrast sensitivity; decrease in aqueous humor	Holds objects far away from face; complains of glare; poor night vision and "dry" eye; difficulty adjusting to changes in light intensity; decreased ability to distinguish colors	Wear eyeglasses and use sunglasses outdoors; avoid abrupt changes from dark to light; use adequate indoor lighting with area lights and nightlights; use large-print books; use magnifier for reading; avoid night driving; use contrasting colors for color coding; avoid glare of shiny surfaces and direct sunlight.
Hearing: Presbycusis; decreased ability to hear high-frequency sounds; tympanic membrane thinning and loss of resiliency; difficulty with sound discrimination especially in noisy environment	Gives inappropriate responses; asks people to repeat words; strains forward to hear; can result in social isolation and increases vulnerability for delirium during hospitalization	Recommend a hearing examination; reduce background noise; face person; enunciate clearly; speak with a low-pitched voice; use nonverbal cues; rephrase questions.
Taste and smell: Decreased ability to taste and smell	Decreased recognition of familiar smells including recognizing spoiled food or a gas stove left on; decreased enjoyment of food; uses excessive sugar and salt	Encourage use of lemon, spices, herbs; recommend smoking cessation.

Adapted from Carpenter, H. (2015). Summer sun safety. American Nurse Today, 10(7), 46. Oster, K. A., & Oster, C. A. (2015). Special needs population: Care of the geriatric patient population in the perioperative setting. AORN Journal, 101(4), 444–456.

changes that in the past were thought to be age related do not consistently appear. For example, the higher blood pressure found in older adults in Western societies does not occur in less-developed societies and may be a result of different lifestyle behaviors rather than normal age-related changes (Miller, 2015). The cardiovascular system can adapt to many normal age-related changes and often an older person is unaware of any significant decline in cardiovascular performance. However, when challenged, for instance, during exercise or stress, the cardiovascular system of an older person is less efficient and may be unable to respond sufficiently when life-sustaining activities are needed.

Careful assessment of older adults is necessary because they often present with different symptoms than those seen in younger patients. Older adults are more likely to have dyspnea or neurologic symptoms associated with heart disease, and they may experience mental status changes or report vague symptoms such as fatigue, nausea, and syncope. Rather than the typical substernal chest pain associated with myocardial ischemia, older patients may report burning or sharp pain or discomfort in an area of the upper body. Complicating the assessment is the fact that many older patients have more than one underlying disease. When a patient complains of symptoms related to digestion and breathing and upper extremity pain, cardiac disease must be considered. The absence of chest pain in an older patient is not a reliable indicator of the absence of heart disease.

Orthostatic and postprandial hypotension may be a concern as well because of decreased baroreflex sensitivity and risk factors such as medications (Miller, 2015). Therefore, it is important to assess blood pressure in two positions. A patient experiencing hypotension should be counseled to rise slowly (from a lying, to a sitting, to a standing position), avoid straining when having a bowel movement, and consider having five or six small meals each day, rather than three, to minimize the hypotension that can occur after a large meal. Extremes in temperature, including hot showers and whirlpool baths, should be avoided.

Respiratory System

The respiratory system compensates well for the functional changes of aging. In general, healthy, nonsmoking older adults show very little decline in respiratory function; however, there are substantial individual variations and aerobic capacity declines with each decade by about 10% from peak performance in the early to mid-20s (Capriotti & Frizzell, 2015). The age-related changes that do occur are subtle and gradual, and healthy older adults are able to compensate for these changes. Diminished respiratory efficiency and reduced maximal inspiratory and expiratory force may occur as a result of calcification and weakening of the muscles of the chest wall. Lung mass decreases and residual volume increases (Grossmann & Porth, 2014).

Conditions of stress, such as illness, may increase the demand for oxygen and affect the overall function of other systems. Like cardiovascular diseases, respiratory diseases manifest more subtly in older adults than in younger adults and do not necessarily follow the typical pattern of cough, chills, and fever. Older adults may exhibit fatigue, lethargy, anorexia, dehydration, and mental status changes (Miller, 2015).

Smoking is the most significant risk factor for respiratory diseases and older adults have a higher rate of smoking, about 20%, compared to the national average of 18% (Cataldo, Peterson, Hunter, et al., 2015). Therefore, a major focus of health promotion activities should be on smoking cessation and avoidance of environmental smoke. Despite marketing by manufacturers, e-cigarettes are not an effective smoking cessation aid nor do they promote health (Cataldo et al., 2015).

Additional activities that help older adults maintain adequate respiratory function include regular exercise, appropriate fluid intake, pneumococcal vaccination, yearly influenza immunizations, and avoidance of people who are ill. Hospitalized older adults should be frequently reminded to cough and take deep breaths, particularly postoperatively, because their decreased lung capacity and decreased cough efficiency predispose them to atelectasis and respiratory infections.

Integumentary System

The functions of the skin include protection, temperature regulation, sensation, and excretion. Aging can interrupt all functions of the skin and affect appearance (Grossman & Porth, 2014). Epidermal proliferation decreases, and the dermis becomes thinner. Elastic fibers are reduced in number and collagen becomes stiffer. Subcutaneous fat diminishes, particularly in the extremities, and less vasodilation renders

the body less able to produce or conserve body heat. These changes lead to lack of fever in circumstances in which fever would normally be present in younger individuals and reduced tolerance to temperature extremes, which increases the likelihood of hypothermia and hyperthermia (Capriotti & Frizzell, 2015). There is also a loss of resiliency with wrinkling and sagging of the skin. The skin becomes drier and more susceptible to burns, injury, and infection. Hair pigmentation may change and balding may occur; genetic factors strongly influence these changes. These changes in the integument reduce tolerance to temperature extremes and sun exposure.

Lifestyle practices are likely to have a large impact on skin changes. Strategies to promote healthy skin function include not smoking, avoiding exposure to the sun, using a sun protection factor of 15 or higher, wearing protective clothing, using emollient skin cream containing petrolatum or mineral oil, avoiding hot soaks in the bathtub, and maintaining optimal nutrition and hydration (Carpenter, 2015). Older adults should be encouraged to have any changes in the skin examined, because early detection and treatment of precancerous or cancerous lesions are essential for the best outcome.

Reproductive System

An outdated perception is that older adults are asexual, but older adults report that a fairly stable and active sex life is an important quality of life issue. Sexual activity declines with the loss of a partner, primarily for women as a result of widowhood and for men as a result of poor heath, erectile dysfunction, medications, and emotional factors. However, although good health is a predictor of sexual activity, older adults with chronic illnesses may be able to have a sexually active life as well. Because of the many factors that influence the ability to be sexually active, nurses and the older person need to understand the physiologic, psychological, and social factors that affect reproductive and sexual functioning as aging progresses (Miller, 2015); (Mola, 2015).

Ovarian production of estrogen and progesterone declines with menopause. Changes that occur in the female reproductive system include thinning of the vaginal wall, along with a shortening of the vagina and a loss of elasticity; decreased vaginal secretions, resulting in vaginal dryness, itching, and decreased acidity; involution (atrophy) of the uterus and ovaries; and decreased pubococcygeal muscle tone, resulting in a relaxed vagina and perineum. Without the use of water-soluble lubricants, these changes may contribute to vaginal bleeding and painful intercourse.

In older men, the testes become less firm but may continue to produce viable sperm up to 90 years of age. At about 50 years of age, production of testosterone begins to diminish (Tabloski, 2013). Decreased libido and erectile dysfunction may develop but are more likely to be associated with factors other than age-related changes. These risk factors include obesity, smoking, cardiovascular disease, neurologic disorders, diabetes, respiratory disease, chronic pain, and many medications (i.e., vasodilators, antihypertensive agents, and tricyclic antidepressants) (Miller, 2015); (Mola, 2015).

In both older men and women, it may take longer to become sexually aroused, longer to complete intercourse, and longer before sexual arousal can occur again. Although a less intense response to sexual stimulation and a decline in sexual activity occurs with increasing age, sexual desire does not disappear. Many couples are unaware of the causes of decreased libido or erectile dysfunction and are often reluctant to discuss decreased sexual function. In fact, one survey revealed that in men with erectile dysfunction, less than half of men had discussed the dysfunction with their primary provider (Mola, 2015). Many nonpharmacologic, pharmacologic, and surgical methods are available to improve sexual relationships. Assessment and communication require sensitivity and expert knowledge in the field of sexual dysfunction. If sexual dysfunction is present, referral to a gynecologist, urologist, or sex therapist may be warranted.

Genitourinary System

The genitourinary system continues to function adequately in older adults, although kidney mass is decreased, primarily because of a loss of nephrons. However, the loss of nephrons does not typically become significant until about 90 years of age, and changes in kidney function vary widely; approximately one third of older adults show no decrease in renal function (Tabloski, 2013). Changes in renal function may be attributable to a combination of aging and pathologic conditions such as hypertension. The changes most commonly seen include a decreased filtration rate, diminished tubular function with less efficiency in reabsorbing and concentrating the urine, and a slower restoration of acid–base balance in response to stress. In addition, older adults who take medications may experience serious consequences owing to decline in renal function because of impaired absorption, decreased ability to maintain fluid and electrolyte balance, and decreased ability to concentrate urine.

Certain genitourinary disorders are more common in older adults than in the general population. In India, nearly half (42.8%) of the women 60 years of age and older suffer from urinary incontinence (i.e., urine leakage or problems controlling urine flow) (Singh, Agarwal, Verma, et al., 2013). This condition should not be mistaken as a normal consequence of aging (Weber & Kelley, 2014). Costly and often embarrassing, it should be evaluated, because in many cases it is reversible or can be treated. (See Chapter 45 for further discussion of urinary incontinence.) Benign prostatic hyperplasia (enlarged prostate gland), a common finding in older men, causes a gradual increase in urine retention and overflow incontinence. Changes in the urinary tract increase the susceptibility to urinary tract infections. Adequate consumption of fluids is an important nursing intervention that reduces the risk of bladder infections and also helps decrease urinary incontinence.

Gastrointestinal System

Digestion of food is less influenced by changes associated with aging than by the risk of poor nutrition. Older adults can adjust to changes in the gastrointestinal system but may have difficulty purchasing, preparing, and enjoying their meals. The sense of smell diminishes as a result of neurologic changes and environmental factors such as smoking, medications, and vitamin B_{12} deficiencies. The ability to recognize sweet, sour, bitter, or salty foods diminishes over time, altering satisfaction with food. Salivary flow does not decrease in healthy adults; however, approximately 31% to 37% of older adults may experience a dry mouth as a result of medications and diseases (Miller, 2015). Difficulties with chewing and swallowing are generally associated with lack of teeth and disease.

Experts disagree on the extent of gastric changes that occur as a result of normal aging. However, gastric motility appears to slow modestly, which results in delayed emptying of stomach contents

and early satiety (feeling of fullness). Diminished secretion of gastric acid and pepsin, seemingly the result of pathologic conditions rather than normal aging, reduces the absorption of iron, calcium, and vitamin B_{12}. Absorption of nutrients in the small intestine, particularly calcium and vitamin D, appears to diminish with age. Functions of the liver, gallbladder, and pancreas are generally maintained, although absorption and tolerance to fat may decrease. The incidence of gallstones and common bile duct stones increases progressively with advancing years.

Difficulty swallowing, or dysphagia, increases with age and is a major health care problem in older patients. Normal aging alters some aspects of the swallowing function. In addition, dysphagia is a frequent complication of stroke and a significant risk factor for the development of aspiration pneumonia that can be life-threatening. Dysphagia is caused by interruption or dysfunction of neural pathways. It may also result from dysfunction of the striated and smooth muscles of the gastrointestinal tract in patients with Parkinson disease. Aspiration of food or fluid is the most serious complication and can occur in the absence of coughing or choking.

Constipation is a common pathologic condition that affects many older people as they age. Symptoms of mild constipation are abdominal discomfort and flatulence; more serious constipation leads to fecal impaction that contributes to diarrhea around the impaction, fecal incontinence, and obstruction. Predisposing factors for constipation include lack of dietary bulk, prolonged use of laxatives, some medications, inactivity, insufficient fluid intake, and excessive dietary fat. Ignoring the urge to defecate may also be a contributing factor.

Practices that promote gastrointestinal health include regular tooth brushing and flossing; receiving regular dental care; drinking sufficient fluids; eating small, frequent meals that are high in fiber and low in fat; avoiding heavy activity or lying flat after eating; and avoiding the use of laxatives and antacids. Understanding that there is a direct correlation between loss of smell and taste perception and food intake helps caregivers intervene to maintain the nutritional health of older patients.

Nutritional Health

The social, psychological, and physiologic functions of eating influence the dietary habits of older adults. Increasing age alters nutrient requirements; older adults require fewer calories and a more nutrient-rich, healthy diet in response to alterations in body mass and a more sedentary lifestyle. Recommendations include reducing fat intake while consuming sufficient protein, vitamins, minerals, and dietary fiber for health and prevention of disease. Decreased physical activity and a slower metabolic rate reduce the number of calories needed by older adults to maintain an ideal weight. As stated previously, age-related changes that alter pleasure in eating include a decrease in taste and smell. Older adults are likely to maintain a taste for sweetness but require more sugar to achieve a sweet flavor. They also may lose the ability to differentiate sour, salty, and bitter tastes. Apathy, immobility, depression, loneliness, poverty, inadequate knowledge, and poor oral health also contribute to suboptimal nutrient intake. Budgetary constraints and physical limitations may interfere with food shopping and meal preparation.

Nursing Alert: Drinking water before a meal may help curb appetite but is not recommended as a way to decrease salt intake. Replacing salt with other flavors, such as herbs and spices, pepper, and lemon, can help decrease salt intake.

Health promotion for older adults is based on the individual's physiologic, pathologic, and psychosocial conditions (Cline, 2014). The goals of nutrition therapy are to maintain or restore maximal independent functioning and health and to maintain the sense of dignity and quality of life by imposing as few restrictions as possible. Dietary changes should be incorporated into the older adult's existing food pattern as much as possible. Figure 62-2 lists modified dietary guidelines for older adults.

Women older than 50 years and men older than 70 years should have a daily calcium intake of 1200 mg. To foster the absorption of calcium, adults should have 600 IU of vitamin D until 70 years of age and 800 IU after 70 years of age to maintain bone health (National Institutes of Health, 2014).

Undernutrition, which can lead to malnutrition, may be a problem for older adults. Hospitalized older adults are at particular risk of malnutrition, especially those with cognitive impairment or dementia (Oster & Oster, 2015). A recent unintentional weight loss may be a result of an illness or other factors, such as depression, that may have serious consequences and affect a person's ability to maintain health and fight illness (Grossman & Porth, 2014). Many people are unaware of dietary deficits. Nurses are in an ideal position to identify nutritional problems among their patients and to work within the patient's own framework of knowledge of their health status to improve health behaviors. (See Chapter 3 for more information on nutritional assessment.)

Sleep

Older adults have increased complaints about their sleep as they age, and as many as 50% of those living at home and 65% of those living in nursing homes complain of sleep disturbances (Daglar, Sabancoigullari, Pinar, et al., 2014). Many factors affect sleep quality in older adults including respiratory problems during sleep, restless leg syndrome, nocturia, pain, osteoarthritis, heart failure, incontinence, prostate hypertrophy, menopause-related problems, pruritus, allergies, AD, depression, dementia, social isolation, loneliness, being bedridden, experiences of loss, drug use, and living in nursing homes (e.g., inadequate lighting, keeping light on during the night, noises). Some of the consequences of poor sleep quality in older adults include cognitive decline, increased risk of falls, daytime fatigue, and reduced physical and mental health and health-related quality of life status (Daglar et al., 2014).

The incidence of sleep apnea (a sleep disorder characterized by brief periods in which respirations are absent) increases with age. Having insomnia symptoms and a sleep-related disorder (snoring, choking, or pauses in breathing) is associated with significantly impaired daytime functioning and longer psychomotor reaction times compared with having either condition. (Sleep apnea is discussed in more detail in Chapter 40.)

The nurse often observes patients while they are sleeping and can identify problems. The nurse can provide health education on sleep hygiene behaviors such as avoiding use of the bed for activities other than sleeping (or sex), maintaining a consistent bedtime routine, avoiding or limiting daytime napping, and limiting alcohol intake to one drink a day. Additional suggestions include avoiding stimulants such as caffeine and nicotine after noon; curbing the amount of liquids in the evening to avoid nocturia; and engaging in regular physical activity, preferably in bright outside light (Daglar et al., 2014).

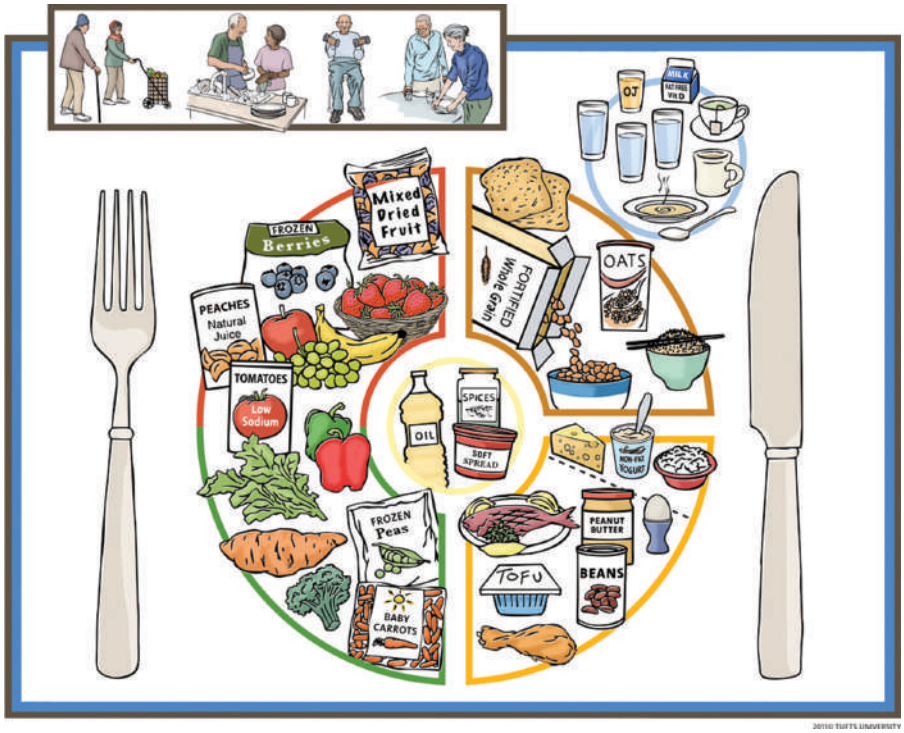


Figure 62-2 • My Plate for older adults. Used with permission from the Jean Mayer USDA Human Nutrition Research Center on Aging (HNRCA) at Tufts University.

Musculoskeletal System

Intact musculoskeletal and neurologic systems are essential for the maintenance of safe mobility, performance of activities of daily living (ADLs) (basic personal care activities), and instrumental activities of daily living (IADLs) (complex skills such as shopping, cooking, housework, using the telephone, managing medications and finances, and being able to travel by car or public transportation), thus allowing older adults to remain safe and live independently in the community. Age-related changes that affect mobility include alterations in bone remodeling, leading to decreased bone density, loss of muscle mass, deterioration of muscle fibers and cell membranes, and degeneration in the function and efficiency of joints. (These factors are discussed in detail in Unit 10.)

Without exercise, a gradual, progressive decrease in bone mass begins before 40 years of age. The cartilage of joints also progressively deteriorates in middle age. Degenerative joint disease is found in most adults older than 70 years, and weight-bearing joint and back pain is a common complaint. Excessive loss of bone density results in osteoporosis, which leads to potentially life-altering hip and vertebral fractures. Osteoporosis is preventable.

The axiom "use it or lose it" is very relevant to the physical capacity of older adults. Nurses play an important role by encouraging older adults to participate in a regular exercise program. The benefits of regular exercise cannot be overstated. Aerobic exercises are the foundation of programs of cardiovascular conditioning; however, resistance and strength training and flexibility exercises are essential components of an exercise program. Even late in life, in adults who may be frail, it is believed that exercise has benefits of increasing strength, aerobic capacity, flexibility, and balance. In addition, older adults who are hospitalized benefit from getting out of bed as soon as possible and in-hospital physical activity (Oster & Oster, 2015).

Nervous System

Homeostasis is difficult to maintain with aging, but older people have a tremendous ability to adapt and function adequately, retaining their cognitive and intellectual abilities in the absence of pathologic changes. However, normal aging changes in the nervous system can affect all parts of the body. The structure, chemistry, and function of the nervous system change with advanced age. Nerve cells in the brain decrease but the decrease is compensated for by other neurons; there is high variability among individuals and the quantity of neuronal loss varies in different parts of the brain. Overall, the decreases contribute to a small loss of brain mass (Capriotti & Frizzell, 2015). Chemical changes include a decrease in the synthesis and metabolism of the major neurotransmitters. Because nerve impulses are conducted more slowly, older people take longer to respond and react (Miller, 2015). The autonomic nervous system performs less efficiently, and postural hypotension, discussed earlier, may occur. Neurologic changes can affect gait and balance, which may interfere with mobility and safety. Nurses must advise older adults to allow a longer time to respond to a stimulus and to move more deliberately. Adequate nutrition and absorption of vitamin B_{12} is important for neurologic health. Nurses should advise older adults about proper nutrition and intake of vitamin B_{12}, especially for older adults who follow a vegetarian diet.

Slowed reaction time puts older adults at risk for falls and injuries, as well as driving errors. Although older adults spend

less time driving than younger people, older adults are just as likely to be involved in motor vehicle crashes that result in serious injury or death. Older adults who are driving unsafely should receive a driving fitness evaluation (Miller, 2015). The evaluation is often given by an occupational therapist in conjunction with a neuropsychologist, who conducts more detailed cognitive testing.

Mental function may be threatened by physical or emotional stresses. A sudden onset of confusion may be the first symptom of an infection or change in physical condition (e.g., pneumonia, urinary tract infection, medication interactions, and dehydration).

Sensory System

People interact with the world through their senses. Losses associated with old age affect all sensory organs, and it can be devastating not to be able to see to read or watch television, hear conversation well enough to communicate, or discriminate taste well enough to enjoy food. Nearly half of older men and one third of older women report difficulty hearing without a hearing aid. Most older adults have a decrease in visual acuity, a narrowing of the visual field, and may have trouble seeing at night (Oster & Oster, 2015). An uncompensated sensory loss negatively affects the functional ability and quality of life of the older adult. However, assistive devices such as visual and hearing aids can compensate for a sensory loss (Oster & Oster, 2015).

Sensory Loss Versus Sensory Deprivation

In contrast to sensory loss, sensory deprivation is the absence of stimuli in the environment or the inability to interpret existing stimuli (perhaps as a result of a sensory loss). Sensory deprivation can lead to boredom, confusion, irritability, disorientation, and anxiety. A decline in sensory input can mimic a decline in cognition that is in fact not present. Meaningful sensory stimulation provided to the older person is often helpful in correcting this problem. In some situations, one sense can substitute for another in observing and interpreting stimuli. Nurses can enhance sensory stimulation in the environment with colors, pictures, textures, tastes, smells, and sounds. The stimuli are most meaningful if they are appropriate for older adults and the stimuli are changed often. Cognitively impaired people tend to respond well to touch and to familiar music.

Vision

As new cells form on the outside surface of the lens of the eye, the older central cells accumulate and become yellow, rigid, dense, and cloudy, leaving only the outer portion of the lens elastic enough to change shape (accommodate) and focus at near and far distances. As the lens becomes less flexible, the near point of focus gets farther away. This common condition—presbyopia—usually begins in the fifth decade of life and requires the person to wear reading glasses to magnify objects (Miller, 2015). In addition, the yellowing, cloudy lens causes light to scatter and sensitivity to glare. The ability to distinguish colors decreases, particularly blue from green. The pupil dilates slowly and less completely because of increased stiffness of the muscles of the iris, thus the older person takes more time to adjust when going to and from light and dark settings and needs brighter light for close vision. Pathologic visual conditions are not a part of normal aging; however, the incidence of eye disease (most commonly cataracts, glaucoma, diabetic retinopathy, and age-related macular degeneration) increases in older adults.

Age-related macular degeneration is the primary cause of vision loss in older adults. An estimated 1.8 million Americans 40 years of age and older are affected by macular degeneration, and that number may reach 2.95 million by 2020 (Centers for Disease Control and Prevention [CDC], 2013). Macular degeneration does not affect peripheral vision, which means that it does not cause blindness. However, it affects central vision, color perception, and fine detail, greatly affecting common visual skills such as reading, driving, and seeing faces. Risk factors include sunlight exposure, cigarette smoking, and heredity. People with fair skin and blue eyes may be at increased risk. Sunglasses and hats with visors provide some protection, and stopping smoking is paramount in preventing the disease. Although there is no definitive treatment and no cure that restores vision, several treatment options are available, depending on factors such as the location of the abnormal blood vessels. Laser photocoagulation and photodynamic therapy are commonly used (Centers for Disease Control and Prevention [CDC], 2013). The earlier this condition is diagnosed, the greater the chances of preserving sight. (See Chapter 42 for more information on altered vision.)

Hearing

Auditory changes begin to be noticed at about 40 years of age. Environmental factors, such as exposure to noise, medications, and infections, as well as genetics, may contribute to hearing loss as much as age-related changes. Presbycusis is a gradual sensorineural loss that progresses from the loss of the ability to hear high-frequency tones to a generalized loss of hearing. It is attributed to irreversible inner ear changes. Older adults often cannot follow conversation because tones of high-frequency consonants (the sounds *f, s, th, ch, sh, b, t, p*) all sound alike. Hearing loss may cause older adults to respond inappropriately, misunderstand conversation, and avoid social interaction. This behavior may be erroneously interpreted as confusion. Wax buildup or other correctable problems may also be responsible for hearing difficulties. A properly prescribed and fitted hearing aid may be useful in reducing some types of hearing deficits. (See Chapter 41 for discussion of alterations in hearing.)

Taste and Smell

The senses of taste and smell are reduced in older adults. Of the four basic tastes (sweet, sour, salty, and bitter), sweet tastes are particularly dulled in older adults. Blunted taste may contribute to the preference for salty, highly seasoned foods, but herbs, onions, garlic, and lemon can be used as substitutes for salt to flavor food.

Changes in the sense of smell, generally greater than the loss of taste, are related to cell loss in the nasal passages and in the olfactory bulb in the brain (Grossman & Porth, 2014). Environmental factors such as long-term exposure to toxins (e.g., dust, pollen, and smoke) contribute to the cellular damage.

Psychosocial Aspects of Aging

Successful psychological aging is reflected in the ability of older adults to adapt to physical, social, and emotional losses and to achieve life satisfaction. Because changes in life patterns are inevitable over a lifetime, older adults need resiliency and coping skills when confronting stresses and change. A positive self-image enhances risk taking and participation in new, untested roles.

Although attitudes toward older adults differ in ethnic subcultures, a subtle theme of ageism—prejudice or discrimination against older adults—predominates in society, and many myths surround aging. Ageism is based on stereotypes—simplified and often untrue beliefs that reinforce society's negative image of older adults. Although older adults make up an extremely heterogeneous and increasingly a racially and ethnically diverse group, these negative stereotypes are sometimes attributed to all older adults.

Fear of aging and the inability of many to confront their own aging process may trigger ageist beliefs. Retirement and perceived nonproductivity are also responsible for negative feelings, because a younger working person may falsely see older people as not contributing to society, as draining economic resources, and may actually feel that they are in competition with children for resources. Concern about the large numbers of older persons leaving the workforce (baby boomers began to turn 65 years of age in 2010) is fueling this debate.

Negative images are so common in society that older adults themselves often believe and perpetuate them. An understanding of the aging process and respect for each person as an individual can dispel the myths of aging. Nurses can facilitate successful aging by recommending health promotion strategies such as anticipatory planning for retirement, including ensuring adequate income, developing routines not associated with work, and relying on other people and groups in addition to spouse to fill leisure time (Pender, Murdaugh, & Parsons, 2014).

Stress and Coping in the Older Adult

Coping patterns and the ability to adapt to stress develop over the course of a lifetime and remain consistent later in life. Experiencing success in younger adulthood helps a person develop a positive self-image that remains solid through old age. A person's abilities to adapt to change, make decisions, and respond predictably are also determined by past experiences. A flexible, well-functioning person will probably continue as such. However, losses may accumulate within a short period of time and become acute. The older person often has fewer choices and diminished resources to deal with stressful events. Common stressors of old age include normal aging changes that impair physical function, activities, and appearance; disabilities from injury or chronic illness; social and environmental losses related to loss of income and decreased ability to perform previous roles and activities; and the deaths of significant others. Many older adults rely strongly on their families and spiritual beliefs for comfort during stressful times.

Living Arrangements

Many older adults relocate in response to changes in their lives such as retirement or widowhood, a significant deterioration in health, or disability. The type of housing they choose depends on their reason for moving. With increasing disability and illness, older adults may move to retirement facilities or assisted living communities that provide some support such as meals, transportation, and housekeeping but otherwise allow them to live somewhat independently. If they develop a serious illness or disability and can no longer live independently or semi-independently, they may need to move to a setting where additional support is available, such as a relative's home or a long-term care or assisted living facility. Often they will seek a location near an adult child's home.

Living at Home or with Family

Most older adults want to remain in their own homes; in fact, they function best in their own environment. The family home and familiar community may have strong emotional significance for them, and this should not be ignored. However, with advanced age and increasing disability, adjustments to the environment may be required to allow older adults to remain in their own homes or apartments (see Chart 62-2). Additional family support or more formal support may be necessary to compensate for declining function and mobility. Many services and organizations can assist older adults to successfully "age in place" in their own homes or in assisted living facilities (see Resources at the end of this chapter).

Chart 62-2 NURSING RESEARCH PROFILE

Care Transitions for Older Adults Discharged Home from the Emergency Department

Cadogan, M. P., Phillips, L. R. & Ziminski, C. E. (2016). A perfect storm: Care transitions for vulnerable older adults discharged home from the emergency department without a hospital admission. The Gerontologist, 56(2), 326–334.

Purpose

Transitions are a vulnerable time for older adults. The purpose of the study was to identify factors that influenced the quality and safety of transitions home for older adults who were discharged directly from the emergency department (ED).

Design

This qualitative descriptive study collected data through nine focus group interviews, with ED staff representing multiple interdisciplinary team members including nurses, physicians, social workers, therapists, and pharmacists. The research was conducted in a level 1 trauma center with approximately 78,000 ED visits per year. The ED is located in an ethnically and economically diverse community in California and does not have a geriatric service.

Findings

Based on the findings from the focus groups, the researchers identified a model of five overlapping concepts that influence the quality and safety for vulnerable older adults who are directly discharged home. The five concepts are the "nature of the geriatric presentation" (e.g., complex and multidimensional), "provider knowledge-base" (information about the patient including home situation), "consumer knowledge-base (ability to successfully manage the health problems), resource-base" (staff mix, time to adequately care for an older, slower patient), and "system fractures" (deficiencies and lack of connections within the health system).

Nursing Implications

Nurses need to understand the underlying factors that contribute to hospital readmission or repeat ED visits for older adult patients who visit the ED. Successful discharge to home uses interventions targeted to the needs of the patient population that clearly extend beyond the ED visit. Some recommended practices include making a follow-up appointment before the patient leaves the ED or referral for a nurse follow-up home visit.



Figure 62-3 • Families are an important source of psychosocial and physical support for all people. Caring interaction among grandchildren, grandparents, and other family members typically contributes to the health of all.

Sometimes older adults or couples move in with adult children. This can be a rewarding experience as the children, their parents, and the grandchildren interact and share household responsibilities (see Fig. 62-3). It can also be stressful, depending on family dynamics. Adult children and their older parents may choose to pool their financial resources by moving into a house that has an attached "in-law suite." This arrangement provides security for the older adult and privacy for both families. Many older adults and their adult children make housing decisions in times of crisis, such as during a serious illness or after the death of a spouse. Caring for an older adult may also be stressful; older adults and their families often are unaware of the emotional and physical demands of shared housing and assuming care for an increasingly dependent person, especially given the uncertain and extended length of time that may be associated with caring for a person with a chronic illness. Families can be helped by anticipatory guidance and long-term planning before a crisis occurs. Older adults should participate in decisions that affect them as much as possible.

Assisted Living Facilities

In the western world, assisted living facilities are an option when an older person's physical or cognitive changes necessitate at least minimal supervision or assistance. Assisted living allows for a degree of independence while providing minimal nursing assistance with administration of medication, assistance with ADLs, or other chronic health care needs. Other services, such as laundry, cleaning, and meals, may also be included. Options of assisted living are costly and primarily paid out of pocket.

Long-Term Care Facilities

In the western world, there is availability of many types of nursing homes, nursing facilities, or long-term care facilities that offer continuous nursing care for elderly. Short-term nursing care facilities are also available to offer care during episodes of acute sickness for older people, which is reimbursed by government health care schemes or some of the older people have their insurance to pay for such short-term sickness care. However, costs of long-term care for older adults who are living in nursing homes and are medically stable, despite having multiple chronic and debilitating health issues, are primarily paid by the patients out of their pockets. In India, such long-term care facilities are not many for elderly and acute or chronic care facilities are availed by them by paying out-of-pocket or from their insurance but very few of them have health insurance.

The Role of the Family

Planning for care and understanding the psychosocial issues confronting older adults must be accomplished within the context of the family. If dependency needs occur, the spouse often assumes the role of primary caregiver. In the absence of a surviving spouse, an adult child may assume caregiver responsibilities and need help in providing or arranging for care and support.

The rapid urbanization and rapidly changing social structure in India has two serious issues: first is that adult children and their aged parents are socially alienated and that adult children abandon their parents when health and other dependency problems arise. However, still the family has been and continues to be an important source of support for older adults; similarly, older family members provide a great deal of support to younger family members.

In most of the cases, adult children are even financially responsible for their older parents and social attitudes and cultural values often dictate that adult children should provide services and assume the burden of care if their aged parents cannot care for themselves. Caregiving, which may continue for many years, can become a source of family stress and is a well-known risk for psychiatric and physical morbidity. Evidence-based interventions to reduce distress and enhance well-being in caregivers have been identified. Three broad types of effective programs include (1) psychoeducational skill building, (2) cognitive behavioral therapy, and (3) using a combination of at least two approaches such as education, family meetings, and skill building sessions (Bakas, Clark, Kelly-Hayes, et al., 2014). Web-based programs can be effective, efficient, and a better fit for the hectic lives of caregivers (Gies, Pierce, Steiner, et al., 2014).

Cognitive Aspects of Aging

Cognition can be affected by many variables, including sensory impairment, physiologic health, environment, sleep, and psychosocial influences. Older adults may experience temporary changes in cognitive function (i.e., delirium) when hospitalized or admitted to skilled nursing facilities, rehabilitation centers, or long-term care facilities. These changes are related to differences in the environment or in medical therapy or to alteration in role performance. A commonly used assessment tool is the Mini-Mental State Examination (MMSE) (see Chart 62-3).

Good sleep hygiene can improve cognition, as can treatment of depression and anxiety. Several researchers are evaluating memory enhancement programs for older adults (McDougall, Vance, Wayde, et al., 2015).

When intelligence test scores from people of all ages are compared, test scores for older adults show a progressive decline beginning in midlife. However, research has shown that environment and health have a considerable influence on scores, and that certain types of intelligence (e.g., spatial perceptions and retention of nonintellectual information) decline, whereas others (e.g., problem-solving ability based on past experiences, verbal comprehension, and mathematical ability) do not. Cardiovascular health, a stimulating environment, and high

Chart 62-3 ASSESSMENT

Assessing Mental Status: Mini-Mental State Examination Sample Items

Orientation to Time

"What is the date?"

Naming

"What is this?" (Point to a pencil or pen.)

Reading

"Please read this and do what it says." (Show examinee the words on the stimulus form.) CLOSE YOUR EYES.

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Chart 62-4 HEALTH PROMOTION

Nursing Strategies for Promoting Cognitive Function

Nurses can support the processes by which older adults learn by using the following strategies:

- Supply mnemonics to enhance recall of related data.
- Encourage ongoing learning.
- Link new information with familiar information.
- Use visual, auditory, and other sensory cues.
- Encourage learners to wear prescription glasses and hearing aids.
- Provide glare-free lighting.
- Provide a quiet, nondistracting environment.
- Set short-term goals with input from the learner.
- Prioritize the most important information and focus on the priority information.
- Keep teaching periods short.
- Pace learning tasks according to the endurance of the learner.
- Encourage verbal participation by learners.
- Reinforce successful learning in a positive manner.

levels of education, occupational status, and income all appear to have a positive effect on intelligence scores in later life.

Significant age-related declines in intelligence, learning, and memory are not inevitable. Many factors affect the ability of older adults to learn and remember and to perform well in testing situations. Older adults who have higher levels of education, good sensory function, good nutrition, and jobs that require complex problem-solving skills continue to demonstrate intelligence, memory, and the capacity for learning. Part of the challenge in testing older adults is determining what is actually being tested (e.g., speed of response) and whether the test results are indicative of a normal age-related change, a sensory deficit, or poor health. However, age differences continue to emerge even with untimed tests and when the tests are controlled for variations in motor and sensory function. In general, fluid intelligence—the biologically determined intelligence used for flexibility in thinking and problem solving—declines. Researchers suggest this decline is related to circulatory and nervous system disorders and is not a normal age-related change (Bergman & Almkvist, 2013). Therefore, preventing or managing these diseases may positively affect the decline in fluid intelligence. Crystallized intelligence—gained through education and lifelong experiences (e.g., verbal skills)—remains intact. These differences exemplify the classic aging pattern of intelligence. Despite these slight declines, many older adults continue to learn and participate in varied educational experiences. Good health and motivation are important influences on learning (see Chart 62-4). An important consideration for learning is allowing adequate time, particularly when new technology is involved (Harris, Thomas, & Fox, 2015).

Pharmacologic Aspects of Aging

Because an increasing number of chronic conditions affect older adults, they use more medications than any other age group. Although medications improve health and well-being by relieving pain and discomfort, treating chronic illnesses, and curing infectious processes, adverse drug reactions are common because of medication interactions, multiple medication effects, incorrect dosages, and the use of multiple medications.

Drug Interactions and Adverse Effects

Polypharmacy is the prescription, use, or administration of more medications than is clinically indicated. Over or incorrect prescribing occurs commonly in older adults (Miller, 2015). The potential for drug–drug interactions increases with increased medication use and with multiple coexisting diseases (comorbidity) that affect the absorption, distribution, metabolism, and elimination of the medications. Such interactions are responsible for numerous emergency department and physician visits, which cost huge money annually.

Any medication is capable of altering nutritional status, and the nutritional health of an older adult may already be compromised by a marginal diet or by chronic disease and its treatment. Medications can affect the appetite, cause nausea and vomiting, irritate the stomach, cause constipation or diarrhea, and decrease absorption of nutrients. In addition, these medications may alter electrolyte balance as well as carbohydrate and fat metabolism. For example, antacids may cause thiamine deficiency; laxatives diminish absorption; antibiotics and phenytoin (Dilantin) reduce utilization of folic acid; and phenothiazines, estrogens, and corticosteroids increase appetite and cause weight gain.

Combining multiple medications with alcohol, as well as with over-the-counter and herbal medications, further complicates gastrointestinal problems.

Altered Pharmacokinetics

Alterations in absorption, metabolism, distribution, and excretion occur as a result of normal aging and may also result from drug and food interactions (Oster & Oster, 2015). Absorption may be affected by changes in gastric pH and a decrease in gastrointestinal motility. Drug distribution may be altered as a result of decrease in body water and increase in body fat. Normal age-related changes and diseases that alter blood flow, liver and renal function, or cardiac output may affect distribution and metabolism (see Table 62-2).

Nursing Implications

Principles that have been identified as appropriate for older patients include starting with a low dose, going slowly,

TABLE 62-2 Altered Drug Responses in Older Adults

Age-Related Changes	Effect of Age-Related Change	Applicable Medications
Absorption		
Reduced gastric acid; increased pH (less acid)	Rate of drug absorption—possibly delayed	Vitamins
Reduced gastrointestinal motility; prolonged gastric emptying	Extent of drug absorption—not affected	Calcium
Distribution		
Decreased circulating plasma proteins and total body water	Serious alterations in drug binding to plasma proteins (the unbound drug gives the pharmacologic response); highly protein-bound medications have fewer binding sites, leading to increased effects and accelerated metabolism and excretion.	*Selected highly protein-binding medications:* Oral anticoagulants (warfarin) Oral hypoglycemic agents (sulfonylureas) Barbiturates Calcium channel blockers Furosemide (Lasix) Nonsteroidal anti-inflammatory drugs (NSAIDs) Sulfonamides Quinidine Phenytoin (Dilantin)
Reduced cardiac output	Decreased perfusion of many bodily organs	
Impaired peripheral blood flow	Decreased perfusion	
Increased or decreased percentage of body fat	Proportion of body fat increases with age, resulting in increased ability to store fat-soluble medications; this causes drug accumulation, prolonged storage, and delayed excretion.	*Selected fat-soluble medications:* Barbiturates Diazepam (Valium) Lidocaine Phenothiazines (antipsychotics) Ethanol Morphine
Decreased lean body mass	Decreased body volume allows higher peak levels of medications.	
Metabolism		
Decreased cardiac output; decreased size of the liver; diminished intestinal and portal vein blood flow	Decreased metabolism and delay of breakdown of medications, resulting in prolonged duration of action, accumulation, and drug toxicity	All medications metabolized by the liver
Excretion		
Decreased renal blood flow; loss of functioning nephrons; decreased renal efficiency	Decreased rates of elimination and increased duration of action; danger of accumulation and drug toxicity	*Selected medications with prolonged action:* Aminoglycoside antibiotics Cimetidine (Tagamet) Chlorpropamide (Diabinese) Digoxin Lithium Procainamide

Adapted from Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

keeping the medication regimen as simple as possible, and reconciling new and previous medication regimens at the time of discharge from an acute hospital stay (Foust & Kilbourne, 2015). A comprehensive assessment that begins with a thorough medication history, including use of alcohol, recreational drugs, and over-the-counter and herbal medications, is essential. It is best to ask the patient or reliable informants to provide all medications for review. Assessing the patient's understanding of when and how to take each medication, as well as the purpose of each medication, allows the nurse to assess the patient's health literacy and compliance with the medication regimen. The patient's beliefs and concerns about the medications should be identified, including beliefs on whether a given medication is helpful.

Nonadherence with medication regimens can lead to significant morbidity and mortality among older adults. The many contributing factors include the number of medications prescribed, the complexity of the regimen, difficulty opening containers, inadequate patient education, financial cost, and the disease or medication interfering with the patient's life. Visual and hearing problems may make it difficult to read or to hear directions. Multifaceted interventions tailored to the individual patient are the most effective strategies in improving adherence (Foust & Kilbourne, 2015) (see Chart 62-5). Allowing enough time for the older adult to learn new skills, particularly when technology is involved, is essential (Harris et al., 2015); (Oster & Oster, 2015).

Mental Health Problems in the Older Adult

Severe mood swings, uncontrolled laughing or crying, changes in cognitive ability, and excessive forgetfulness are not a part of normal aging. These symptoms should not be dismissed as age-related changes; a thorough assessment may reveal a

Chart 62-5

Nursing Strategies for Improving Medication Management and Adherence

The following strategies can help patients manage their medications and improve adherence:

- Assess self-management abilities, psychomotor skills, and current medication knowledge.
- Explain the purpose, adverse effects, and dosage of each medication, particularly those that are newly prescribed.
- Provide the medication schedule in writing.
- Encourage the use of standard containers without safety lids (if there are no children in the household).
- Suggest the use of a multiple-day, multiple-dose medication dispenser to help the patient adhere to the medication schedule.
- Destroy or remove old, unused medications.
- Encourage the patient to inform the primary provider about the use of over-the-counter medications and herbal agents, alcohol, and recreational drugs.
- Encourage the patient to keep a current list of all medications, including over-the-counter and herbal medications, in their purse or wallet to share with the primary provider at each visit and in case of an emergency.
- Reconcile medication schedule upon discharge from hospital or rehabilitation facility.
- Recommend using one supplier for prescriptions; pharmacies frequently track patients and are likely to notice a prescription problem such as duplication or contraindications in the medication regimen.
- If the patient's competence is doubtful, identify a reliable family member or friend who might assist the patient with adherence.

Adapted from Foust, J. B., & Kilbourne, G. A. (2015). Improving posthospital medication management for chronically ill older adults. American Nursing Today. 10(3), 26–29.

treatable, reversible condition. Changes in mental status can be related to many factors, such as alterations in diet and fluid and electrolyte balance, fever, or low oxygen levels associated with many cardiovascular and pulmonary diseases. Older adults are less likely than younger people to acknowledge or seek treatment for mental health symptoms. Changes may be reversible when the underlying condition is identified and treated. Nurses must recognize, assess, refer, collaborate, treat, and support older adults who exhibit signs and symptoms of depression, substance abuse, delirium, or dementia.

Depression

Depression is the most common affective or mood disorder of old age. The percentage of older adults with depressive symptoms varies widely depending upon the measures used and the population studied. Modiga, Midlov, and Kristensson (2014) reported that between 7% and 29% of older adults have depressive symptoms. Depression among older adults can follow a major precipitating event or loss and is often related to chronic illness or pain. It may also be secondary to a medication interaction or an undiagnosed physical condition. Rather than obvious sadness, an older person may exhibit more subtle signs of depression such as fatigue, diminished memory and concentration, feelings of worthlessness, sleep disturbances, appetite disturbances with excessive weight loss or gain, restlessness, impaired attention span, and suicidal ideation. Mild depression with symptoms that do not meet the criteria for a major depression is often underrecognized and undertreated, which results in reduced quality of life and function (Modiga et al., 2014).

The risk of suicide is increased in older adults. There is a need for routine assessment of patients for depression and risk for suicide. Geriatric depression may be confused with dementia. However, the cognitive impairment resulting from depression is related to apathy rather than decline in brain function. When depression and medical illnesses coexist, as they often do, neglect of the depression can impede physical recovery. Assessing the patient's mental status, including depression, is vital and must not be overlooked. A commonly used assessment tool is the Geriatric Depression Scale (GDS) (see Chart 62-6).

Older adults with depression can respond appropriately to treatment. Initial management involves evaluation of the patient's medication regimen and eliminating or changing any medications that contribute to depression. Furthermore, treatment of underlying medical conditions that may produce depressive symptoms may alleviate the depression. For mild depression, nonpharmacologic measures such as exercise, bright lighting, increasing interpersonal interactions, cognitive therapy, and reminiscence therapy are effective. However, for major depression, antidepressants and short-term psychotherapy, particularly in combination, are effective in older adults. Antidepressants, such as bupropion hydrobromide (Wellbutrin), venlafaxine hydrochloride (Effexor), and mirtazapine (Remeron), as well as selective serotonin reuptake inhibitors, such as paroxetine hydrochloride (Paxil), can be effective (Comerford, 2015). Tricyclic antidepressants can be useful for treating major depression in some patients. Electroconvulsive therapy is highly effective when antidepressant medications are not tolerated, not effective, or pose a significant medical risk (Miller, 2015).

Most antidepressant medications have anticholinergic, cardiac, and orthostatic adverse effects (Comerford, 2015). They also interact with other medications and, therefore, should be used with care to avoid medication toxicity, hypotensive events, and falls. Older patients prescribed antidepressants should be carefully monitored for side effects. Good patient education is needed to make sure older adults understand that it may take even longer than the typical 4 to 6 weeks for symptoms to diminish. During this period, nurses should offer support, encouragement, and strategies to maintain safety, such as changing positions slowly and maintaining adequate hydration (Miller, 2015).

Substance Abuse

Substance abuse caused by misuse of alcohol and drugs may be related to depression. Large number of elderly are reported to have alcohol, tobacco, and other substance abuse. Moderate levels of alcohol consumption may be associated with positive health risks, such as lowering the risks for cardiovascular disease. Alcohol abuse, while rare, is especially dangerous in older adults because of age-related changes in renal and liver function as well as the high risk of interactions with prescription medications and the resultant adverse effects. Alcohol and drug-related problems in older adults often remain hidden because many older adults deny their habit when questioned. Assessing for drug and alcohol use with direct questions in a nonaccusatory manner should be part of the routine physical assessment (AoA, 2012b). (See Chapter 3 for more information and specific assessment tools.)

Chart 62-6

Geriatric Depression Scale

Choose the best answer for how you felt this past week.

[a]1. Are you basically satisfied with your life?	YES	NO
2. Have you dropped many of your activities and interests?	YES	NO
3. Do you feel that your life is empty?	YES	NO
4. Do you often get bored?	YES	NO
[a]5. Are you hopeful about the future?	YES	NO
6. Are you bothered by thoughts you can't get out of your head?	YES	NO
[a]7. Are you in good spirits most of the time?	YES	NO
8. Are you afraid that something bad is going to happen to you?	YES	NO
[a]9. Do you feel happy most of the time?	YES	NO
10. Do you often feel helpless?	YES	NO
11. Do you often get restless and fidgety?	YES	NO
12. Do you prefer to stay at home, rather than going out and doing new things?	YES	NO
13. Do you frequently worry about the future?	YES	NO
14. Do you feel you have more problems with memory than most?	YES	NO
[a]15. Do you think it is wonderful to be alive now?	YES	NO
16. Do you often feel downhearted and blue?	YES	NO
17. Do you feel pretty worthless the way you are now?	YES	NO
18. Do you worry a lot about the past?	YES	NO
[a]19. Do you find life very exciting?	YES	NO
20. Is it hard for you to get started on new projects?	YES	NO
[a]21. Do you feel full of energy?	YES	NO
22. Do you feel that your situation is hopeless?	YES	NO
23. Do you think that most people are better off than you are?	YES	NO
24. Do you frequently get upset over little things?	YES	NO
25. Do you frequently feel like crying?	YES	NO
26. Do you have trouble concentrating?	YES	NO
[a]27. Do you enjoy getting up in the morning?	YES	NO
28. Do you prefer to avoid social gatherings?	YES	NO
[a]29. Is it easy for you to make decisions?	YES	NO
[a]30. Is your mind as clear as it used to be?	YES	NO

Score: _____ (*Number of "depressed" answers*)

Norms

Normal: 5 ± 4

Mildly depressed: 15 ± 6

Very depressed: 23 ± 5

[a]Appropriate (nondepressed) answers = yes; all others = no.

From Yesavage, J., Brink, T. L., Rose, T. L., et al. (1983). Development and validation of a geriatric screening scale: A preliminary report. Journal of Psychiatric Research, 17(1), 37–49. Reprinted with permission from Pergamon Press Ltd., Headington Hill Hall, Oxford OX3 OBW, UK.

Delirium

Delirium, often called *acute confusional state,* begins with disorientation and if not recognized and treated can progress to changes in level of consciousness, irreversible brain damage, and sometimes death. Patients may experience an altered level of consciousness, ranging from stupor (hypoalert–hypoactive) to excessive activity (hyperalert–hyperactive); alternatively, they may have a combination of these two types (mixed). Thinking is disorganized, and the attention span is short. Hallucinations, delusions, fear, anxiety, and paranoia may also be evident. Patients who tend to be hyperalert and hyperactive demand more attention from nurses and thus are easier to diagnose, whereas those who are hypoalert or hypoactive tend to be less problematic and pose diagnostic difficulties. Recognition of delirium can also be complicated in patients with the mixed disorders. Patients with the hypoalert–hypoactive type of delirium have higher mortality rates and even poorer outcomes of care because the delirium tends not to be recognized and treated (Layne et al., 2015).

Attentive clinical assessment is essential because delirium is sometimes mistaken for dementia; Table 62-3 compares dementia and delirium. It helps to know an individual patient's usual mental status and whether the changes noted are long term, which probably represents dementia, or are abrupt in onset, which is more likely delirium.

TABLE 62-3 Summary of Differences Between Dementia and Delirium

	Dementia		
	Alzheimer's Disease (AD)	Vascular (Multi-Infarct) Dementia	Delirium
Etiology	Early onset (familial, genetic [chromosomes 14, 19, 21]) Late-onset sporadic–etiology unknown	Cardiovascular (CV) disease Cerebrovascular disease Hypertension	Drug toxicity and interactions; acute disease; trauma; chronic disease exacerbation Fluid and electrolyte disorders
Risk factors	Advanced age; genetics	Pre-existing CV disease	Pre-existing cognitive impairment
Occurrence	70% of dementias	10–20% of dementias	7–61% among hospitalized people
Onset	Slow	Often abrupt Follows a stroke or transient ischemic attack	Rapid, acute onset A harbinger of acute medical illness
Age of onset	Early-onset AD: 30s–65 years Late-onset AD: 65+ years Most commonly: 85+ years	Most commonly 50–70 years	Any age, although predominantly in older persons
Gender	Males and females equally	Predominantly males	Males and females equally
Course	Chronic, irreversible; progressive, regular, downhill	Chronic, irreversible Fluctuating, stepwise progression	Acute onset Hypoalert—hypoactive Hyperalert–hyperactive Mixed hypo–hyper
Duration	2–20 years	Variable; years	Lasts 1 day to 1 month
Symptom progress	Onset insidious: *Early*—mild and subtle *Middle and late*—intensified Progression to death (infection or malnutrition)	Depends on location of infarct and success of treatment; death attributed to underlying CV disease	Symptoms are fully reversible with adequate treatment; can progress to chronicity or death if underlying condition is ignored.
Mood	Depression common	Labile: mood swings	Variable
Speech/language	Speech remains intact until late in disease: *Early*—mild anomia (cannot name objects); deficits progress until speech lacks meaning; echoes and repeats words and sounds; mutism	May have speech deficit/aphasia depending on location of lesion	Fluctuating; often cannot concentrate long enough to speak May be somnolent
Physical signs	*Early*—no motor deficits *Middle*—apraxia (cannot perform purposeful movement) *Late*—Dysarthria (impaired speech) *End stage*—loss of all voluntary activity; positive neurologic signs	According to location of lesion: focal neurologic signs, seizures Commonly exhibits motor deficits	Signs and symptoms of underlying disease
Orientation	Becomes lost in familiar places (topographic disorientation) Has difficulty drawing three-dimensional objects (visual and spatial disorientation) Disorientation to time, place, and person—with disease progression		May fluctuate between lucidity and complete disorientation to time, place, and person
Memory	Loss is an early sign of dementia; loss of recent memory is soon followed by progressive decline in recent and remote memory		Impaired recent and remote memory; may fluctuate between lucidity and confusion
Personality	Apathy, indifference, irritability: *Early disease*—social behavior intact; hides cognitive deficits *Advanced disease*—disengages from activity and relationships; suspicious; paranoid delusions caused by memory loss; aggressive; catastrophic reactions		Fluctuating; cannot focus attention to converse; alarmed by symptoms (when lucid); hallucinations; paranoid
Functional status, activities of daily living	Poor judgment in everyday activities; has progressive decline in ability to handle money, use telephone, use computer and other electronic devices, function in home and workplace		Impaired
Attention span	Distractible; short attention span		Highly impaired; cannot maintain or shift attention
Psychomotor activity		Wandering, hyperactivity, pacing, restlessness, agitation	Variable; alternates between high agitation, hyperactivity, restlessness, and lethargy
Sleep–wake cycle	Often impaired; wandering and agitation at nighttime		Takes brief naps throughout day and night

Adapted from Grossman, S. C., & Porth, C. M. (2014). Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Delirium occurs secondary to numerous causes, including physical illness, surgery, medication or alcohol toxicity, dehydration, fecal impaction, malnutrition, infection, head trauma, lack of environmental cues, and sensory deprivation or overload. Older adults are particularly vulnerable to acute confusion because of their decreased biologic reserve and the large number of medications they may take. Nurses must recognize the symptoms of delirium and report them immediately. The

Confusion Assessment Method is a commonly used screening tool (Inouye, van Dyck, Alessi, et al., 1990); (Layne et al., 2015). (See Chart 62-7). Because of the acute and unexpected onset of symptoms and the unknown underlying cause, delirium is a medical emergency. If the delirium goes unrecognized and the underlying cause is not treated, permanent, irreversible brain damage or death can follow.

The most effective approach is prevention. Strategies include providing therapeutic activities for cognitive impairment, reorienting the patient as needed, ensuring early mobilization, controlling pain, minimizing the use of psychoactive drugs, preventing sleep deprivation, enhancing communication methods (particularly eye glasses and hearing aids) for vision and hearing impairment, maintaining oxygen levels and fluid and electrolyte balance, and preventing surgical complications (Layne et al., 2015); (Miller, 2015).

Once delirium occurs, treatment of the underlying cause is most important. Therapeutic interventions vary depending on the cause. Delirium increases the risk of falls; therefore, management of patient safety and behavioral problems is essential. Because medication interactions and toxicity are often implicated, the nurse should alert the prescriber about any nonessential medications that could be discontinued. Nutritional and fluid intake should be supervised and monitored. The environment should be quiet and calm. To increase function and comfort, the nurse provides familiar environmental cues and encourages family members or friends to touch and talk to the patient (see Fig. 62-4). Ongoing mental status assessments using prior mental cognitive status as a baseline are helpful in evaluating responses to treatment and upon admission to a hospital or extended care facility. If the underlying problem is adequately treated, the patient often returns to baseline within several days. Several resources specific to delirium are included in the Resources section at the end of the chapter.

Dementia

The cognitive, functional, and behavioral changes that characterize dementia eventually destroy a person's ability to function. The symptoms are usually subtle in onset and often progress slowly until they are obvious and devastating. The most common type of dementia is AD that accounts for up to

Chart 62-7 ASSESSMENT

Confusion Assessment Method

Acute Onset

1. Is there evidence of an acute change in mental status from the patient's baseline?

Inattention[a]

2. A. Did the patient have difficulty focusing attention, for example, being easily distractible, or having difficulty keeping track of:
   What was being said?
   Not present at any time during interview.
   Present at some time during interview but in mild form.
   Present at some time during interview, in marked form.
   Uncertain.
   B. (If present or abnormal) Did this behavior fluctuate during the interview, that is, tend to come and go or increase and decrease in severity?
   Yes.
   No.
   Uncertain.
   Not applicable.
   C. (If present or abnormal) Please describe this behavior:

Disorganized Thinking

3. Was the patient's thinking disorganized or incoherent, such as rambling or irrelevant conversation, unclear or illogical flow of ideas, or unpredictable switching from subject to subject?

Altered Level of Consciousness

4. Overall, how would you rate this patient's level of consciousness?
   Alert (normal).
   Vigilant (hyperalert, overly sensitive to environmental stimuli, startled very easily).
   Lethargic (drowsy, easily aroused).
   Stupor (difficult to arouse).
   Coma (unarousable).
   Uncertain.

Disorientation

5. Was the patient disoriented at any time during the interview, such as thinking that he or she was somewhere other than the hospital, using the wrong bed, or misjudging the time of day?

Memory Impairment

6. Did the patient demonstrate any memory problems during the interview, such as inability to remember events in the hospital or difficulty remembering instructions?

Perceptual Disturbances

7. Did the patient have any evidence of perceptual disturbances, for example, hallucinations, illusions, or misinterpretations (such as thinking something was moving when it was not)?

Psychomotor Agitation

8. Part 1.
   At any time during the interview, did the patient have an unusually increased level of motor activity, such as restlessness, picking at bedclothes, tapping fingers, or making frequent sudden changes of position?

Psychomotor Retardation

8. Part 2.
   At any time during the interview, did the patient have an unusually decreased level of motor activity, such as sluggishness, staring into space, staying in one position for a long time, or moving very slowly?

Altered Sleep–Wake Cycle

9. Did the patient have evidence of disturbance of the sleep–wake cycle, such as excessive daytime sleepiness with insomnia at night?

[a]The questions listed under this topic were repeated for each topic where applicable.

From Inouye, S. K., van Dyck, C. H., Alessi, C. A., et al. (1990). Clarifying confusion: The confusion assessment method. Annals of Internal Medicine, 113(12), 941–948. Used with permission.



Figure 62-4 • Talking to family members may increase the comfort of patients with delirium.

70% of older adults with dementia (Grossman & Porth, 2014). Other non-Alzheimer dementias include degenerative, vascular, neoplastic, demyelinating, infectious, inflammatory, toxic, metabolic, and psychiatric disorders. It is important to identify reversible dementia, which occurs when pathologic conditions masquerade as dementia.

Vascular Dementia

Vascular dementia is the second most common cause of dementia and is characterized by an uneven, stepwise downward decline in mental function (Grossman & Porth, 2014). Multi-infarct dementia, the most common form of vascular dementia, has an unpredictable course and is characterized by variable impairment depending on the affected sites in the brain. The patient may present with a deficit in only one domain such as word retrieval whereas other cognitive abilities may be intact. Diagnosis may be even more difficult if a patient has both vascular dementia and AD.

Because vascular dementia is associated with hypertension and cardiovascular disease, risk factors (e.g., hypercholesterolemia, smoking, heart disease, diabetes) are similar. Prevention and management are also similar. Measures to decrease blood pressure, control diabetes, and lower cholesterol levels may slow cognitive decline.

Additional Aspects of Health Care of the Older Adult

The nurse needs to consider other health issues of older adults. These include pseudobulbar affect, geriatric syndromes, elder neglect and abuse, as well as ethical and legal issues.

Pseudobulbar Affect

The condition known as pseudobulbar affect involves inappropriate or exaggerated emotional expression, usually episodes of laughing or crying. It is associated with brain injury (e.g., stroke, traumatic brain injury, multiple sclerosis [MS], amyotrophic lateral sclerosis [ALS], AD, and Parkinson disease). The term "pseudobulbar" refers to damage that occurs in the corticobulbar tracts in the brain (see Chapter 53). The emotional outbursts can cause embarrassment, anxiety, and depression, and often impair quality of life (Yang & Deeks, 2015).

Older adults with pseudobulbar affect can respond appropriately to treatment. Initial management involves evaluation and recognition that this condition can coexist with mood disorders, such as depression, although crying in these patients should not be considered indicative of depression. Pharmacology studies have reported effective management with Nuedexta (dextromethorphan HBr and quinidine sulfate) in patients with ALS, MS, and dementia (Yang & Deeks, 2015).

Geriatric Syndromes

Older adults tend to acquire multiple problems and illnesses as they age. The decline of physical function leads to a loss of independence and increasing frailty as well as to susceptibility to both acute and chronic health problems, which generally result from several factors rather than from a single cause. When combined with a decrease in host resistance, these factors can lead to illness or injury. Some problems commonly experienced by older adults are becoming recognized as geriatric syndromes. These conditions do not fit into discrete disease categories and require a multidisciplinary and comprehensive assessment to identify the underlying cause or causes. Examples include skin impairment, poor nutrition, falls or functional decline, incontinence, cognitive impairment, skin impairment, and sleep disturbances (Brown-O'Hara, 2014). Although these conditions may develop slowly, the onset of symptoms is often acute. Furthermore, the presenting symptoms may appear in other body systems before becoming apparent in the affected system. For example, an older patient may present with confusion, and the underlying disease may be a urinary tract infection, dehydration, or a heart attack (Carlson, Merel, & Yukawa, 2015).

The term *geriatric triad* includes changes in cognitive status, falls, and incontinence. This term is used to focus awareness on these three conditions, which need particular attention and the implementation of prevention measures during the hospitalization of older patients.

Impaired Mobility

The causes of decreased mobility are many and varied. Common causes include strokes, Parkinson disease, diabetic neuropathy, cardiovascular compromise, osteoarthritis, osteoporosis, and sensory deficits. To avoid immobility, older people should be encouraged to stay as active as possible. During illness, bed rest should be kept to a minimum, even with hospitalized patients, because brief periods of bed rest quickly lead to deconditioning and, consequently, to a wide range of complications. When bed rest cannot be avoided, patients should perform active range-of-motion and strengthening exercises with the unaffected extremities, and nurses or family caregivers should perform passive range-of-motion exercises on the affected extremities. Frequent position changes help offset the hazards of immobility. Both the health care staff and the patient's family can assist in maintaining the current level of mobility.

Dizziness

Older adults frequently seek help for dizziness, which presents a particular challenge because there are numerous possible causes. For many, the problem is complicated by an inability to differentiate between true dizziness (a sensation of disorientation in relation to position) and vertigo (a spinning

sensation). Other similar sensations include near-syncope and disequilibrium. The causes for these sensations range in severity from minor (e.g., buildup of ear wax) to severe (e.g., dysfunction of the cerebral cortex, cerebellum, brain stem, proprioceptive receptors, or vestibular system). Even a minor reversible cause, such as ear wax impaction, can result in a loss of balance and a subsequent fall and injury. Because dizziness has many predisposing factors, nurses should seek to identify any potentially treatable factors related to the condition.

Falls and Falling

Accidental injuries rank eighth as a cause of death for older people, and falls are the most common cause of nonfatal injuries and hospital admissions. The incidence of falls rises with increasing age. One out of five falls in older adults results in serious injury such as broken bones or a head injury (CDC, 2015).

Although many falls by older adults do not result in injury, between 20% and 30% of older adults who fall sustain moderate to serious injury. Overall, older women who fall sustain a greater degree of injury than do older men; however, men are more likely to die of a fall injury (CDC, 2015). Hip fracture is a common type of fracture that can occur as a result of a fall. Many older adults who fall and sustain a hip fracture are unable to regain their prefracture ability. Causes of falls are multifactorial. Both extrinsic factors such as changes in the environment or poor lighting and intrinsic factors such as physical illness, neurologic changes, or sensory impairment play a role. Mobility difficulties, medication effects, foot problems or unsafe footwear, postural hypotension, visual problems, and tripping hazards are common and treatable causes. Polypharmacy, medication interactions, and the use of alcohol precipitate falls by causing drowsiness, decreased coordination, and postural hypotension. Falls have physical dangers as well as serious psychological and social consequences. It is not uncommon for an older person who has experienced a fall to become fearful and lose self-confidence (Miller, 2015).

Nurses can encourage older adults and their families to make lifestyle and environmental changes to prevent falls. Adequate lighting with minimal glare and shadow can be achieved through the use of small area lamps, indirect lighting, sheer curtains to diffuse direct sunlight, dull rather than shiny surfaces, and nightlights. Sharply contrasting colors can be used to mark the edges of stairs. Grab bars by the bathtub, shower, and toilet are useful. Loose clothing, improperly fitting shoes, scatter rugs, small objects, and pets create hazards and increase the risk of falls. Older adults function best in familiar settings when the arrangement of furniture and objects remains unchanged.

Nursing Alert: In hospitalized and institutionalized older adults, physical restraints (lap belts; geriatric chairs; side rails, vest, waist, and jacket restraints) and chemical restraints (medications) precipitate many of the injuries they were meant to prevent. Because of the acute negative consequences of restraint use, accrediting agencies of nursing homes and acute care facilities now maintain stringent guidelines for correct application and use.

Urinary Incontinence

Urinary incontinence may be acute, occurring during an illness, or may develop chronically over a period of years. Older patients often do not report this very common problem unless specifically asked. Transient causes may be attributed to *d*elirium and *d*ehydration; *r*estricted mobility; *i*nflammation, *i*nfection, and *i*mpaction; and *p*harmaceuticals and *p*olyuria (the acronym *drip* may be used to remember them). Once identified, the causative factor can be eliminated.

Older patients with incontinence should be urged to seek help from appropriate health care providers because incontinence can be both emotionally devastating and physically debilitating. Nurses who specialize in behavioral approaches to urinary incontinence management can help patients regain full continence or significantly improve the level of continence. Although medications such as anticholinergics may decrease some of the symptoms of urge incontinence (detrusor instability), the adverse effects of these medications (dry mouth, slowed gastrointestinal motility, and confusion) may make them inappropriate choices for older adults. Various surgical procedures are also used to manage urinary incontinence, particularly stress urinary incontinence.

Detrusor hyperactivity with impaired contractility is a type of urge incontinence that is seen predominantly in the older adult population. In this variation of urge incontinence, patients have no warning that they are about to urinate. They often void only a small volume of urine or none at all and then experience a large volume of incontinence after leaving the bathroom. Nurses should be familiar with this form of incontinence and not show disapproval when it occurs. Many patients with dementia suffer from this type of incontinence, because both incontinence and dementia are a result of dysfunction in similar areas of the brain. Prompted, timed voiding can be of assistance in these patients, although clean intermittent catheterization may be necessary because of postvoid residual urine. (See Chapter 45 for information on management of urinary disorders.)

Increased Susceptibility to Infection

Infectious diseases present a significant threat of morbidity and mortality to older adults, in part because of the blunted response of host defenses caused by a reduction in both cell-mediated and humoral immunity (see Chapters 54 and 55). Age-related loss of physiologic reserve and chronic illnesses also contribute to increased susceptibility. Pneumonia, urinary tract infections, gastrointestinal infections, and skin infections are some of the common infections in older adults.

Because of a weakened immune response, the effects of influenza and pneumococcal infections on older adults are significant. Vaccination can help prevent both infections. There is a national goal to increase vaccination rates among persons 65 years of age and older. More than 70% of those 65 years of age and older reported receiving an influenza vaccination between January and June 2014 and 61% reported that they had received a pneumococcal vaccination (Administration on Aging [AoA], 2014).

Influenza and pneumococcal vaccinations lower the risks of hospitalization and death in older adults. The influenza vaccine, which is prepared yearly to adjust for the specific immunologic characteristics of the influenza viruses at that time, should be given annually in autumn. Recent research suggests that better protection is provided with the high-dose, trivalent, inactivated influenza vaccine versus the standard vaccine in older adults (DiazGranados, Dunning, Kimmel, et al., 2014). The pneumococcal vaccine should be given every 5 years. Both of these injections can be received at the same time in separate

injection sites. Nurses should urge older adults to be vaccinated. All health care providers working with older adults or high-risk chronically ill people should also be immunized.

AIDS occurs across the age spectrum. It is increasingly recognized that AIDS does not spare the older segment of society, and many who are living with HIV/AIDS are aging.

Atypical Responses

Many altered physical, emotional, and systemic reactions to disease are attributed to age-related changes in older adults. Physical indicators of illness that are useful and reliable in young and middle-aged people cannot be relied on for the diagnosis of potential life-threatening problems in older adults. The response to pain in older adults may be lessened because of reduced acuity of touch, alterations in neural pathways, and diminished processing of sensory data.

Older adults who are experiencing a myocardial infarction may not have chest pain but present with confusion. Hiatal hernia or upper gastrointestinal distress is often the cause of chest pain. Therefore, acute abdominal conditions may go unrecognized in older adults because of atypical signs and absence of pain.

The baseline body temperature for older adults is about 1°F lower than it is for younger people (Weber & Kelley, 2014). In the event of illness, the body temperature of an older person may not be high enough to qualify as a traditionally defined fever. A temperature of 37.8°C (100°F) in combination with systemic symptoms may signal infection. A temperature of 38.3°C (101°F) almost certainly indicates a serious infection that needs prompt attention. A blunted fever in the face of an infection often indicates a poor prognosis. Temperatures rarely exceed 39.5°C (103°F). Nurses must be alert to other subtle signs of infection, such as mental confusion, increased respirations, tachycardia, and a change in skin color.

Altered Emotional Impact

The emotional component of illness in older adults may differ from that in younger people. Many older adults equate good health with the ability to perform their daily activities and believe that "you are as old as you feel." An illness that requires hospitalization or a change in lifestyle is an imminent threat to well-being. Older adults admitted to the hospital are at high risk for disorientation, confusion, change in level of consciousness, and other symptoms of delirium, as well as anxiety and fear. In addition, economic concerns and fear of becoming a burden to families often lead to high anxiety in older adults. Nurses must recognize the implications of fear, anxiety, and dependency in older patients. They should encourage autonomy, independent decision making, and early mobilization. A positive and confident demeanor in nurses and family members promotes a positive mental outlook in older patients.

Altered Systemic Response

In an older person, illness has far-reaching repercussions. The decline in organ function that occurs in every system of the aging body eventually depletes the body's ability to respond at full capacity. Illness places new demands on body systems that have little or no reserve to meet the crisis. Homeostasis is jeopardized. Older adults may be unable to respond effectively to an acute illness or, if a chronic health condition is present, they may be unable to sustain appropriate responses over a long period. Furthermore, their ability to respond to definitive treatment is impaired. The altered responses of older adults reinforce the need for nurses to monitor all body system functions closely, being alert to signs of impending systemic complication.

Elder Neglect and Abuse

Older adults are at risk for abuse and neglect both in the community setting and in nursing homes (Burnes, Phillemer, Caccamise, et al., 2015). Because of different definitions and terminology and the pattern of underreporting, a clear picture of the incidence and prevalence of abuse among older adults is lacking. Furthermore, one of the major barriers to fully understanding elder abuse is that most professionals in all professions, including law enforcement, are not equipped to recognize and report this type of abuse. Often victims are reluctant to report the abuse and clinicians are unaware of the frequency of the problems.

Neglect is the most common type of abuse. Other forms of abuse include physical, psychological or emotional, sexual, abandonment, and financial exploitation or abuse. Burnes and colleagues (2015) reported factors associated with physical and emotional abuse included being separated or divorced, living in a low income household, functional impairment, and younger age for community dwelling older adults. Neglect was associated with poor health, living below the poverty level, being separated or divorced, and younger age. Neglect was lowest in Hispanic households (Burnes et al., 2015).

Physical abuse associated with staff misconduct in long-term care facilities has received much attention in the past decade, but one study examined a less commonly investigated problem, that of resident on resident abuse (Schiamberg, von Heydrich, Chee, et al., 2015). This is a significant problem as Schiamberg and colleagues (2015) reported that the rate of this type of abuse was 17% in a sample of more than 450 family members interviewed. Factors associated with resident on resident abuse in a nursing home setting were reported as previous staff physical or emotional abuse; younger age; limitations in ADLs and IADLs; and the emotional closeness of the resident to their family (Schiamberg et al., 2015). Older adults with disabilities of all types are at increased risk for abuse from family members, paid caregivers, and staff, whether they live in the community or a long-term care facility.

Nurses should be alert to possible elder abuse and neglect. During the health history, the older adult should be asked about abuse during a private portion of the interview. Most states require that care providers, including nurses, report suspected abuse. Preventive action should be taken when caregiver strain is evident—before elder abuse occurs. Early detection and intervention may provide sufficient resources to the family or the person at risk to ensure patient safety. Interdisciplinary team members, including the psychologist, social worker, can be enlisted to help the caregiver develop self-awareness, increased insight, and an understanding of the disease or aging process.

National Programme for Health Care of the Elderly and Social Schemes for the Elderly

The National Programme for Health Care of the Elderly (NPHCE) was launched by the Ministry of Health and Family Welfare during 2010–2011. The program is trying to integrate the elderly care services through the existing National Rural Heath Mission, AYUSH, and Ministry of Social Justice so that active and healthy aging is achieved. It is implemented through the state health societies and district health societies.

Objectives of the National Health Programme for Elderly

These are as follows:

1. Provide accessible, affordable, and high-quality long-term, comprehensive, and dedicated care services to an aging population.
2. Create an enabling environment for the elderly.

Strategies for Implementation of National Health Programme for Elderly

- **Preventive and promotive care:** Provide awareness to the elderly and their caregivers on the importance of regular exercise, balanced diet, lifestyle changes such as cessation of smoking and alcohol, and teach regarding how to prevent falls. In addition, regular monitoring and assessment of the elderly through the weekly geriatric clinics is recommended.
- **Curative services to elderly:** Dedicated geriatric OPDs will be developed at the primary health centers, community health centers, and OPD and IP services in district hospitals and regional geriatric centers. The district hospital will be functioning with a dedicated geriatric OPD and 10-bedded IP services to manage and treat chronic disabling diseases with the funds from the state and central governments.
- **Developing needed health manpower:** Medical and paramedical personnel will be trained in geriatric management using standardized modules. At regional geriatric centers, the MD geriatric medicine courses will be offered to meet the need for specialized geriatric doctors.
- **Rehabilitative services:** Therapeutic exercises, training the elderly on ADL, and pain treatment through the physiotherapy modalities will be delivered at CHC, district-level hospitals, and regional geriatric centers. The needed equipment and supplies are provided to enable the provision of rehabilitative services.
- **Development of IEC material:** IEC material related to the elderly care is prepared and sent to the public for use.

Services Provided Under the National Programme for Elderly

The program is implemented by setting up of state-level and district-level health societies. Under this program, 20 regional geriatric care centers have been established with 30-bedded inpatient and outpatient facilities. These centers train doctors in MD geriatric medicine, conduct geriatric researches, etc. (Ministry of Health and Family Welfare, 2017). District-level hospitals (325 no.) are equipped with dedicated geriatric OPD and 10-bedded IP facility. Inpatient care, OPD services, and physiotherapy services are provided to the elderly in the district hospitals.

Several other pension schemes are launched by the government for elderly from time to time, such as Integrated Programme for Older Persons (IPOP), Rashtriya Vayoshri Yojana (RVY), and The Pradhan Mantri Vaya Vandana Yojana (PMVVY) which provide financial security to elderly.

Health Care Costs of Aging

Health care is a major expenditure for older adults, especially for those with chronic illness and limited financial resources. Older adults, who make up about >8% of the population, accounted for major health care costs, particularly in the last year of life. There are several other pension schemes and recently launched National Programme for the Health Care of Elderly (NPHCE) by government of India. However, major health care cost is borne by elderly themselves through out-of-pocket expenditure or their insurance.

Home Health Care

The use of home care services and skilled nursing home care increases with age. Most of the home healthcare is met by private care providers and untrained staff available in the community, and the cost of home care is primarily borne by the elderly through out-of-pocket expenditure.

Hospice Services

Hospice is a program of supportive and palliative services for patients with advanced illness and their families. In most cases, patients are not expected to live longer than 6 months. Hospice care focuses on quality of life, and by necessity, it usually includes realistic emotional, social, spiritual, and financial preparation for death. The goal of hospice is to improve the quality of life by focusing on symptom management, pain control, and emotional support. Hospice services may be incorporated into the care of residents in long-term care facilities and include care for end-stage dementia and other chronic diseases such as end-stage heart failure (Ersek & Carpenter, 2014). (For an in-depth discussion of end-of-life care, see Chapter 59.)

Aging with a Disability

As the life expectancy of people with all types of physical, cognitive, and mental disabilities has increased, individuals must deal with the normal changes associated with aging in addition to their preexisting disabilities. There are still large gaps in our understanding of the interaction between disabilities and aging, including how this interaction varies depending on the type and degree of disability and other factors such as socioeconomics and gender. For adults without disabilities, the changes associated with aging may be minor inconveniences. For adults with disorders such as MS, aging is associated with higher rates of secondary health conditions compared to those aging without a disability (Newland, Jenson, Budhathoki, et al., 2015). Many people with disabilities are greatly concerned about what will happen to them as they age and whether assistance will be available when they need care.

It has been proposed that nurses view people with disabilities as capable, responsible individuals who are able to function effectively despite having a disability. Both the interface and the biopsychosocial models of disability can serve as a basis for the role of nurses as advocates for removal of barriers to health care (Sharts-Hopko, Smeltzer, Ott, et al., 2010). The use of such models would also encourage public policies that support full participation of all citizens through greater availability of personal assistants and affordable and accessible transportation.

Today, children born with intellectual and physical disabilities and those who acquire them early in life are also living into middle and older age. Often, their care has been provided by the family, primarily by the parents. As parents age and can no longer provide the needed care, they seek additional help with the care or long-term care alternatives for their children.

However, few services are available at present to support a smooth transition between caregiving by parents and then by others. Research and public policy must focus on supports and interventions that allow people with disabilities who are aging to increase or maintain function within their personal environment as well as in the outside community. Important questions include who will provide the care and how will it be financed. The National Institute on Aging has identified aging with a disability as a focus and is striving to provide streamlined information and access to those with a disability and their family caregivers.

Ethical and Legal Issues Affecting the Older Adult

Nurses play an important role in supporting and informing patients and families when making treatment decisions. This nursing role becomes even more important in the care of aging patients who are facing life-altering and possibly end-of-life decisions. Loss of rights, victimization, and other serious problems might occur if a patient has not made plans for personal and property management in the event of disability or death. As advocates, nurses should encourage end-of-life discussions and educate older adults to prepare advance directives before incapacitation (Miller, 2015).

When such serious decisions are made, possibilities exist for significant conflict of values among patients, family members, health care providers, and the legal representative. Autonomy and self-determination are Western concepts, and people from different cultures may view advance directives as a method for denial of care. Older adults from some cultures may be unwilling to consider the future, or they may wish to protect relatives and not want them to be informed about a serious illness. Nurses can facilitate the decision-making process by being sensitive to the complexity of patients' values and respecting their decisions. Directives must be focused on the wishes of the patient, not those of the family or the designated proxy.

If no advance arrangement has been made and the older person appears unable to make decisions, the court may be petitioned for a competency hearing. If the court rules that an older adult is incompetent, the judge appoints a guardian—a third party who is given powers by the court to assume responsibility for making financial or personal decisions for that person.

People with communication difficulties or mild dementia tend to be viewed as incapable of self-determination. However, people with mild dementia may have sufficient cognitive capability to make some, but perhaps not all, decisions. For example, a patient may be able to identify a proxy decision maker and yet be unable to select specific treatment options. People with mild dementia may be competent to understand the nature and significance of different options for care.

Nursing homes are also mandated to enhance residents' autonomy by increasing their involvement in health care decision making. In both nursing homes and hospitals, the documentation and placement of advance directives in the medical record and the education of patients about advance directives vary considerably. Periodically, it is important to ensure that the directives reflect the current wishes of the patient and that all providers have a copy so that they are aware of the patient's wishes.

CRITICAL THINKING EXERCISES

1. As a new nurse working in a busy medical-surgical unit, you notice that some of the older patients are presenting with a relatively flat affect. What do you suspect may be the cause of this flattened affect? What screening tool(s) would you recommend for these patients? Would you recommend that these tools be used for every older patient? Why? What follow-up would you recommend? What is the strength of the evidence base guiding your assessment, actions, and recommendations?
2. An 82-year-old woman has been admitted to the emergency department three times in the past 6 months for a fall without a major injury. What are some possible causes of these frequent falls? What essential assessments would you perform? What referrals would you make and why?
3. During a posthospitalization home visit for an 81-year-old man with diabetes and an extensive cardiac history, you attempt to do medication reconciliation. The patient admits to some forgetfulness and even confusion about his complex medication schedule. How should you proceed? Identify priorities and strategies that may be helpful to the patient so that he can adhere to the regimen.

REFERENCES

*Asterisk indicates nursing research.
**Double asterisk indicates classic reference.

Books

American Nurses Association (ANA). (2010). Gerontological nursing: Scope and standards of practice. Silver Spring, MD: Author.

Capriotti, T., & Frizzell, J. P. (2015). Pathophysiology: Introductory concepts and clinical perspectives. Philadelphia, PA: FA Davis.

Comerford, K. C. (2015). Nursing 2015 drug handbook. Philadelphia, PA: Wolters Kluwer.

Grossman, S. C., & Porth, C. M. (2014). Pathophysiology: Concepts of altered health states (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Miller, C. A. (2015). Nursing for wellness in older adults (7th ed.). Philadelphia, PA: Wolters Kluwer.

Pender, N. J., Murdaugh, C. L., & Parsons, M. A. (Eds.). (2014). Health promotion in nursing practice (7th ed.). Upper Saddle River, NJ: Prentice Hall Health.

Tabloski, P. A. (2013). Gerontological nursing: The essential guide to clinical practice (3rd ed.). Upper Saddle River, NJ: Prentice Hall Health.

Weber, J. R., & Kelley, J. H. (2014). Health assessment in nursing (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Journals and Electronic Documents

Administration on Aging (AoA). (2012b). *Older Americans behavioral health issue brief 2: Alcohol misuse and abuse prevention.* Retrieved on 9/23/2015 at: www.aoa.acl.gov/AoA_Programs/HPW/Behavioral/docs2/Issue%20Brief%202%20Alcohol%20Misuse.pdf

Administration on Aging (AoA). (2014). *A profile of older Americans: 2014.* Retrieved on 9/22/2015 at: www.aoa.acl.gov/Aging_Statistics/Profile/Index.aspx

Ahn, H., Garvan, C., & Lyon, D. (2015). Pain and aggression in nursing home residents with dementia. Nursing Research, 64(4), 256–263.

Bakas, T., Clark, P.C. Kelly-Hayes, M., et al. (2014). Evidence for stroke family caregiver and dyad interventions. Stroke, 45(7), 1–17.

Bergman, L., & Almkvist, O. (2013). The effect of age on fluid intelligence is fully mediated by physical health. Archives of Gerontology and Geriatrics, 57(1), 100–109.

Brown-O'Hara, P. (2014). Geriatric syndromes and their implications for nursing. Journal of Legal Nurse Consulting, 25(2) 8–11.
Burnes, D., Phillemer, K., Caccamise, P. L., et al. (2015). Prevalence of and risk factors for elder abuse and neglect in the community: A population-based study. Journal of the American Geriatric Society, 63(9), 1906–1912.
Cadogan, M. P., Phillips, L. R. & Ziminski, C. E. (2016). A perfect storm: Care transitions for vulnerable older adults discharged home from the emergency department without a hospital admission. The Gerontologist, 56(2), 326–334.
Carlson, C., Merel, S. E, & Yukawa, M. (2015). Geriatric syndromes and geriatric assessment for the generalist. The Medical Clinics of North America, 99(2), 263–279.
Carpenter, H. (2015). Summer sun safety. American Nurse Today, 10(7), 46.
Cataldo, J. K., Peterson, A. B., Hunter, M., et al. (2015). E-cigarette marketing and older smokers: Road to renormalization. American Journal of Health Behaviors, 39(3), 361–371.
Centers for Disease Control and Prevention (CDC). (2013). *Vision health initiative*. Retrieved on 10/11/2015 at: www.cdc.gov/visionhealth/basic_information/eye_disorders.htm
Centers for Disease Control and Prevention (CDC). (2015). *Important facts about falls*. Retrieved on 11/17/2015 at: www.cdc.gov/homeandrecreationalsafety/falls/adultfalls.html
Chang, Y., Chu, H., Yang, C., et al. (2015). The efficacy of music therapy for people with dementia: A meta-analysis of randomized controlled trials. Journal of Clinical Nursing, 24(23–24):3425–3440.
*Cline, D. D. (2014). A concept analysis of individualized aging. Nursing Education Perspectives, 35(3), 185–192.
*Daglar, G., Sabancoigullari, S., Pinar, S. E., et al. (2014). Sleep quality in the elderly either living at home or in a nursing home. Australian Journal of Advanced Nursing, 31(4), 6–13.
DiazGranados, C. A., Dunning, A. J., Kimmel, M., et al. (2014). Efficacy of high-dose versus standard-dose influenza vaccine in older adults. New England Journal of Medicine, 371, 635–645.
Ersek, M., & Carpenter, J. G. (2014). Geriatric palliative care in long term care settings with a focus on nursing homes. Journal of Palliative Medicine, 16(10), 1180–1187.
Foust, J. B., & Kilbourne, G. A. (2015). Improving posthospital medication management for chronically ill older adults. American Nursing Today, 10(3), 26–29.
*Gies, C., Pierce, L., Steiner, V., et al. (2014). Web-based psychosocial assessment for caregivers of persons with dementia: A feasibility study. Rehabilitation Nursing, 39(2), 102–109.
Harris, L., Thomas, V., & Fox, M. (2015). The influence of health care literacy on the use of PHRs among older adults. Medsurg Nursing, 24(4), 383–385.
**Inouye, S. K., van Dyck, C. H., Alessi, C. A., et al. (1990). Clarifying confusion: The confusion assessment method. Annals of Internal Medicine, 113(12), 941–948.
Jin, K. (2010). Modern biological theories of aging. Aging and Disease, 1(2), 72–74.
Kochanek, K. D., Murphy, S. L., Xu, J., et al. (2014). Deaths: Preliminary data for 2013. National Vital Statistics Report No. 178. 1–7.
Layne, T., Haas, S. A., Davidson, J. E., et al. (2015). Postoperative delirium prevention in the older adult: An evidence-based process improvement project. Medsurg Nursing, 24(4), 256–263.
Livingston, G., Kelly, L., Lewis-Holmes, E., et al. (2014). Non-pharmacological interventions for agitation in dementia: Systematic review of randomized controlled trials. The British Journal of Psychiatry, 205, 436–442.
*McDougall, G. J., Vance, D. E., Wayde, E., et al. (2015). Memory training plus yoga for older adults. Journal of Neuroscience Nursing, 47(2), 178–188.
Ministry of Health and Family Welfare. (n.d). National Program for Health Care of Elderly, National Health Mission. Retrieved on 1/24/2022 at: https://nhm.gov.in/index1.php?lang=1&level=2&sublinkid=1046&lid=605.
Ministry of Statistics and Programme Implementation (2016). Elderly India, 2016 report. Retrieved on 03/12/2018 at: http://mospi.nic.in/sites/default/files/publication_reports/ElderlyinIndia_2016.pdf.
Modiga, S., Midllov, P., & Kristensson, J. (2014). Depressive symptoms among frail elderly in ordinary living: Who is affected and who is treated? Aging & Mental Health, 18(8), 1022–1028.
Mola, J. R. (2015). Erectile dysfunction in the older adult male. Urologic Nursing, 35(2), 87–93.
National Institutes of Health (NIH). (2014). *Dietary supplement fact sheet: Vitamin D*. Retrieved on 10/11/2015 at: https://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/
*Newland, P., Jensen, M. P., Budhathoki, C., et al. (2015). Secondary health conditions in individuals with multiple sclerosis: A cross-sectional web-based survey analysis. Journal of Neuroscience Nursing, 47(3), 124–130.
Oster, K. A., & Oster, C. A. (2015). Special needs population: Care of the geriatric patient population in the perioperative setting. AORN Journal, 101(4), 444–456.
Schiamberg, L. B., von Heydrich, L., Chee, G., et al. (2015). Individual and contextual determinants of resident-on-resident abuse in nursing homes: A random sample telephone survey of adults with an older family member in a nursing home. Archives of Gerontology and Geriatrics, 61(2), 277–284.
*Sharts-Hopko, N. C., Smeltzer, S., Ott, B. B., et al. (2010). Healthcare experiences of women with visual impairment. Clinical Nurse Specialist, 24(3), 149–153.
Sherva, R., & Kowall, N. W. (2015). Genetics of Alzheimer disease. In DeKosky, S. T., Raby, B. A., & Eichler, A.F. (Eds.). UpToDate. Retrieved on 10/7/2015 at: www.uptodate.com
Singh, U., Agarwal, P., Verma, M. L, Dalena, D., Singh, N., Shankar, P, (2013). Prevalence and risk factors of urinary incontinence in Indian women: A hospital based survey. Indian Journal of Urology, 29(1), 31–36.
Weuve, J., Hebert, L. E., Scherr, P. A., et al. (2014). Deaths in the United States among persons with Alzheimer's disease (2010–2050). Alzheimer's & Dementia, 10(2), e40–e46.
Yang, L. P., & Deeks, E. D. (2015). Dextromethorphan/Quinidine: A review of its use in adults with pseudobulbar affect. Drugs, 75, 83–90.
**Yesavage, J., Brink, T. L., Rose, T. L., et al. (1983). Development and validation of a geriatric screening scale: A preliminary report. Journal of Psychiatric Research, 17(1), 37–49.

Resources

Administration on Aging (AoA), www.aoa.gov
Alzheimer's Association, www.alz.org
American Association for Geriatric Psychiatry (AAGP), www.aagponline.org
American Association of Retired Persons (AARP), www.aarp.org
American Federation for Aging Research (AFAR), www.afar.org
American Geriatrics Society (AGS), www.americangeriatrics.org
Association for Gerontology in Higher Education (AGHE), www.aghe.org
Children of Aging Parents (CAPS), www.caps4caregivers.org
Family Caregiver Alliance (FCA), www.caregiver.org
Gerontological Society of America (GSA), www.geron.org
Hartford Institute for Geriatric Nursing, www.consultgerirn.org
Hospital Elder Life Program (HELP), www.hospitalelderlifeprogram.org
LeadingAge (formerly American Association of Homes and Services for the Aging), www.leadingage.org
www.alz.org/care/dementia-medic-alert-safe-return.asp
National Caucus and Center on Black Aging (NCBA), www.ncba-aged.org
National Council on Aging (NCOA), www.ncoa.org
National Gerontological Nursing Association (NGNA), www.ngna.org
National Institute on Aging (NIA), Alzheimer's Disease Education and Referral (ADEAR) Center, www.nia.nih.gov/Alzheimers

UNIT

XXI Critical Care Nursing

Chapter 63 Assessment and Management of Patients with Critical Illness 2061

CHAPTER

63

Assessment and Management of Patients with Critical Illness

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Explain the concept and principles of critical care.
2. Describe the organization of an intensive care unit (ICU).
3. Discuss the protocols and standards of ICU.
4. Elucidate the infection control measures in ICU.
5. Detail the role of nurse in assessment and management of critically ill patients.
6. Describe the steps of basic and advanced cardiac life support.
7. Identify the legal and ethical issues arising in the critical care nursing practice.
8. Recognize the impact of critical illness on patient and family.
9. Appreciate the importance of effective communication in the critical care unit.
10. Explain the dosage, mechanism, action, side effects, and nursing implication of the drugs used in critical care unit.

GLOSSARY

advanced cardiac life support: series of clinical interventions in emergency situations such as stroke or a cardiac arrest applying a highly specialized knowledge and skill set by trained healthcare team members

advance directive: a legal document executed by a competent person that provides guidance for medical and healthcare decisions (such as the termination of life support or organ donation) in the event the person becomes incompetent to make such decisions

cardiopulmonary arrest: cessation of heart and lung function characterized by absence of patient responses, pupillary dilatation, and carotid pulse, with no spontaneous breathing

cardiopulmonary resuscitation: emergency measures to bring back the spontaneous breathing and circulation in a patient whose heart stops beating and not breathing by self; includes prompt recognition, artificial breathing, and cardiac compression

catheter-associated urinary tract infection (CAUTI) bundle: set of evidence-based interventions proposed to prevent urinary tract infection among patients as a result of introduction and presence of urinary catheter

catheter-related bloodstream infection or central line–associated bloodstream infection (CRBSI/CLABSI) bundle: set of evidence-based interventions aimed at prevention of laboratory confirmed bloodstream infection in which central line is in place within 48 hours before the development of the bloodstream infection.

central venous pressure: blood pressure in the larger central veins such as in the internal jugular or subclavian vein; reflects the adequacy of circulating blood volume

continuous cardiac monitoring: continuous observation of cardiac functions using the recording of electrical activity of heart

critical care nursing: a specialty of nursing that focuses on care of patients with life-threatening health problems requiring continuous monitoring and advanced treatment

do not resuscitate (DNR): the cessation and removal of an ongoing medical therapy such as withdrawal of dialysis for a patient with renal failure or withdrawal of ventilator support to a patient with acute respiratory failure with an intent of allowing the patient to embrace natural death due to underlying illness

endotracheal intubation: insertion of a breathing tube (type of artificial airway) through the nose or mouth into the trachea

ethical dilemma: a situation that presents with difficulty in decision making between the two alternatives with neither one being absolutely acceptable and both contradicting with each other in professional values

euthanasia: an intentional killing of a person whose life is perceived to be not worth living by an act of commission or omission

health surrogate: legally authorized person to take healthcare decision on behalf of another individual through a living will or advance directive when he or she becomes incompetent

hemodynamic monitoring: process of measuring the various pressures that reflect the circulatory status of the patient at any point of time

hypoxemia: decreased oxygen level in the blood

mechanical ventilation: process of delivering air in and out of lung through a mechanical device connected to the patient who could not sustain spontaneous breathing

nosocomial infection or hospital-acquired infection: an infection acquired in hospital by a patient who was admitted for a reason other than that infection; an infection occurring in a patient 48 hours after admission in a hospital or other healthcare facility in whom the specific organism was not present or incubating at the time of admission

pulseless electrical activity (PEA) condition: defect in which electrical activity is present on an electrocardiogram, but there is not an adequate pulse or blood pressure

ventilator-associated pneumonia (VAP) bundle: set of evidence-based interventions aimed at prevention of VAP

Introduction

Critical care nursing is a well-developed specialty of nursing that focuses on care of patients with life-threatening health problems requiring continuous monitoring and advanced treatment. With invention of various lifesaving gadgets and development of technology, management of the critically ill has become more sophisticated. The intricate nature of critical care necessitates advanced preparation and specialized training of nurses to deal with the critically ill.

Intensive care, also known as critical care, is a multidisciplinary and interprofessional specialty dedicated to the comprehensive management of patients having, or at risk of developing, acute, life-threatening organ dysfunction. Intensive

care uses an array of gadgets that provide support of failing organ systems, particularly the lungs, cardiovascular system, and kidneys (Marshall, Bosco, Adhikari, et al., 2017).

The concept of critical care was introduced by Ms. Florence Nightingale in the 1800s. During the Crimean War, she created a space adjacent to the nurses' station and pooled all the soldiers with severe injuries, thereby enabling the nurses to monitor and care for them more intensively. The precursor concept of Nightingale was enriched and advanced to critical care nursing in the current days. During the polio epidemic in 1952, the first intensive care unit (ICU) was organized in Copenhagen. The polio-afflicted patients were nursed in iron lungs. Within the subsequent decades, in most of the European countries and America, ICUs were developed. Now the critical care units are an integral part of any healthcare facility.

In the 1960s, physicians started having training in critical care such as coronary care, nephrology, and postoperative care. Alongside, the nurses also started having additional training in critical care. Having specialized skill sets and knowledge, nurses started giving emergency resuscitation and assumed the expanded roles. Today, the critical care is collaborative care rendered by the team consisting of intensivist, other specialists, critical care nurses, critical care nurse specialist, and other trained allied health personnel.

Principles of Critical Care Nursing

1. **Astute assessment and continuous monitoring:** Nurses need to be smart in making quick but accurate assessment of patient status. The dynamic nature of alterations in vital organ functions warrants early identification and treatment. Delay in identification and initiation of appropriate intervention may lead to catastrophic consequences. By virtue of the specialized training, critical care nurses monitor closely and continuously the critically ill patients. Critical care nurses must apply the advanced assessment skills and carefully observe the cardiopulmonary, neurological, and renal system functions and document these parameters from time to time. Proficiency in advanced assessment and complex procedures and competency in handling gadgets such as ventilators, hemodynamic monitors, defibrillators, extracorporeal membrane oxygenator (ECMO) machine, bedside dialysis unit, and intra-aortic balloon pump forms a core component of critical care nursing skills.
2. **Anticipation of complications:** Anticipation and identification of evolving complications facilitates timely intervention to avert deterioration in the patient's condition. Critical care nurse collaborates with the critical care consultants, other specialist physicians, and other health team members. Utilizing the specialized advanced knowledge and critical thinking, nurses analyze the trends in various parameters and distinguish early the deviations and alerting parameters of complications. Critical care nurse initiates proactive measures using the evidence-based guidelines, critical care pathways, and care bundles before complications erupt as a consequence of aggressive management of critical condition and use of technology. Nurses need to be aware of and vigilant for possible unexpected outcomes, anticipate adverse reaction, and monitor for side effects for best outcome. Initiation of infection care bundles, deep vein thrombosis prophylaxis, pressure ulcer prevention, sepsis prevention bundle, and delirium prevention bundles are to be implemented efficiently to ensure quality care.
3. **Collaboration:** Critical care warrants a team approach and every member of the team deserves recognition for his or her irreplaceable contribution for the provision of high-quality critical care. Patients may get admitted to the critical care unit with life-threatening single-organ or multiple organ dysfunction. Prompt diagnosis of critical illness, initiation of treatment, and evaluation of the effectiveness of medical and nursing intervention need perfect collaboration and team approach. Critical care nurses in association with other team members take active participation to salvage the patient. If even one member breaches the standardized protocols, the success becomes immaterial. Contribution of every member of the team, including the housekeeping personnel, is mandatory for successful infection control. All those involved in the care of the critically ill have to be abreast of the latest protocols and new changes in policies and guidelines. Periodic training and induction training of all categories of workers are essential for quality care.
4. **Comprehensive care:** Provide comprehensive care by applying independent and interdependent nursing interventions including selected proven alternative care modalities. Most of the patients in ICU may be incapable of complaining their pain, fatigue, or anxiety. Prompt pain assessment, implementation of nonpharmacological measures to improve comfort and alleviate anxiety, prevention of bed sore, emotional support, and reassurance to the suffering patients and family are essential elements for quick recovery.
5. **Communication:** Skillful communication within the critical care team is the basis of all quality care in ICU. It facilitates smooth functioning of ICU team and prevents the patient safety mishaps. Proper communication within the nursing team members leads to quality outcomes. Standardized communication between handoffs can provide smooth continuous care.

   Because of the critical nature of illness, patients may not communicate verbally, or may present with altered consciousness. Reassurance and informing them of the elements of care and their purposes go a long way in improving patient satisfaction and cooperation. Uncertainty thrown upon their face may lead to shock state in many family members. Communicate with the patient and family members truthfully and empathetically. Convey compassion and communicate in such a way that the patient's and family members' anxiety and stress are diminished. Nurses have to apply strategic communication technique to help solve the crisis and in deserving special occasions, collaborate with clinical psychologist/counselor with advanced crisis intervention techniques.
6. **Ethical and humanistic care:**
   - Provide humanistic care in the high-tech environment. The critical care environment is frightening to almost all critically ill patients and their relatives. The human dimensions of care such as love, sense of belonging, and making sense of the intervention by involving the patient to the extent possible to him or her are essential elements in the ICUs that cannot be compromised for high-tech care.
   - ICU is the area in any healthcare facility where the highest number of deaths and disability occur. Handling death or serious loss of body function is complicated and requires competency and delicacy in handling the bereaved ones. Breaking bad news has to follow a certain

protocol so that the bereaved family members are supported well physically, emotionally, and spiritually. Nurses help in meeting the spiritual needs of the dying patients according to their beliefs and cultural norms.

Intensive Care Unit

Definition

An intensive care unit or critical care unit is a geographical area in a hospital where the patients with life-threatening illness or injuries are cared. ICU is the area of the hospital where the sickest patient and gadgets capable to manage them are more concentrated. The Intensive Care Society of the United Kingdom (2013) defines an ICU as a specially staffed and equipped self-contained area in a hospital dedicated to the management and monitoring of patients with life-threatening illness. It provides vital functions and uses the skills of medical, nursing, and other personnel experienced in the management of those problems.

Classification

ICUs may be classified according to the availability of qualified staff, the complexity to the care delivered, and the specialty:

- **Level I ICU:** It is located in a small hospital, providing resuscitation and short-term pulmonary support for less than 24 hours.
- **Level II ICU:** It is an adult ICU located in a larger hospital with a qualified intensivist and provides multisystem support. It may lack in some form of advanced therapy.
- **Level III ICU:** It is an adult ICU located in a large tertiary care center with the capability of providing comprehensive critical care for a prolonged period of time. This type of ICU is manned by a qualified multidisciplinary team consisting of critical care medicine consultant, fellowship trainee, specialist from other discipline, critical care specialized nurses, nurse practitioners, and other qualified allied health personnel.

Other Types of Classification of ICU

- **Open ICU:** Open ICU is one where a group of critically ill patients may be treated and managed not by critical care medicine qualified consultants but by different specialists. Sometimes, the patient may be followed up by the treating primary physician.
- **Closed ICU:** Closed ICU is an ICU that is managed by a qualified critical care specialized physician round the clock 24 × 7. Patient care management decisions are taken primarily by the intensive care consultant.

Single Specialty ICU Versus Multidisciplinary ICU

Based on the type of patients, the ICU can be classified as multidisciplinary critical care unit or single specialty critical units such as medical ICU, surgical ICU, cardiothoracic ICU, and renal ICU. Since the pathophysiological processes and the management modalities are the same, and the gadgets needed to support failing organs are the same irrespective of cause, multidisciplinary ICU is considered cost-effective compared with single specialty ICU (Manimala & Subashini, 2003).

High-Dependency Unit

A high-dependency unit (HDU) provides intermediary care, a unit that can provide smooth transition from ICU to the general ward. It can be a step-down unit for the patients at risk of developing another acute episode of a serious ailment. In the HDU, invasive monitoring and support for single-organ failure is offered for those with a high risk of clinical deterioration or unpredicted clinical course. For all practical purposes, the HDU should be an extension of ICU and it should be managed by a qualified intensivist.

Organization of a Critical Care Unit

Design Consideration

Critical care unit is a vital arena in the hospital and organization of a critical care unit is a strategically planned process. The bed strength, the type of patients, and services intended decide the ICU needs in terms of floor space, equipment, monitors, manpower, etc. The accrediting agencies, JCI, and critical care societies of the countries also have recommended minimum set norms. The Indian hospitals follow the minimum set criteria of the National Accreditation Board for Hospitals (NABH) and Indian Society of Critical Care Medicine (ISCCM), which vary from country to country (Arora, 2012) (see Fig. 63-1).

Bed Strength

To provide effective care, ICU should have 6 to 14 beds (Rungta, Govil, Nainan, et al., 2010). In an ICU with a larger number of beds, it has to be divided into pods containing 10 to 15 beds with sufficient staffs, devoted medical registrar, and intensive care specialist for effective care.

Location

- Critical care unit has to be ideally located in a separate area with easy accessibility to the emergency department (ED), operation room (OR), radiology department, catheterization laboratory, and blood bank.
- There should be sufficiently big lift, ramps, and a wide corridor that can facilitate smooth transfer in and out of the critically ill patients.
- ICU should have a single entry and exit with an anteroom.
- There should be provision for emergency exits in case of disasters.

The Floor Space

- Recommendations vary between countries and the agencies.



Figure 63-1 • ICU in a tertiary care center. (*Courtesy*: Kovai Medical Center and Hospital, Coimbatore.)

- Floor space: 125 to 150 sq ft. per patient is recommended (Rungta et al., 2010). It may vary up to 250 ft^2 per patient. The floor space for a separate room should be much higher, at least 300 ft^2 per patient.
- Between-bed space: There should be 4 to 4.5 ft space between two beds and the beds separated with a removable partition. The head end should also have enough space for easy patient access for intubation or resuscitation.
- Separate rooms: There should be one or two separate rooms to nurse patients requiring isolation precaution or to nurse immunocompromised patients. The room should be big with handwashing facility and area to accommodate the ventilators, monitors, and other gadgets.
- It may be wise to have one or two bigger rooms or an area that may be utilized for patients who may undergo big bedside procedures such as ECMO and renal replacement therapy and those who have large number of gadgets attached to them.
- One hundred percent to 150% extra space is recommended for other than patient care area for nurses' station, storage space, and free patient movement.

Nurses' Station

There should be a central nursing station with telemonitoring devices. This will enable monitoring of patients placed ideally in a "C" or "L" fashion.

Other Facilities

- Storage space for ventilators, monitors, and infusion pumps, room for doctor's office, nurse's office, and toilets have to be provided.
- There should be medical storage (e.g., gloves, medicines, airways, suction tips, catheters, Ryles tubes) facility, medicine preparation area, equipment storage (infusion pump and other equipment), secretarial and computational facility, clean linen storage, seminar room with a small library, and dirty utility room available within the ICU.
- It is always preferred to have clear-cut zoning with patient care areas, support areas, and dirty utility and toilets in other areas. For movement of dirty utilities, there should be a separate pathway.
- There may be provision of RO-purified water access within the ICU.
- There should be a minimum of two to three oxygen outlets, two to three vacuum outlets, and one to three compressed air outlets.
- Sixteen to 18 electric outlets per patient are recommended.
- There should be sufficient natural lighting available. Wall-mounted or ceiling-mounted pendent-type lights are preferable to save space and for good illumination.
- Handwashing facility should be easily accessible. Isolation ICU should have separate handwashing facility.

Environmental Criteria

The ICUs should be fully air conditioned with control of humidity and moisture. Twelve to 16 air exchanges and 55% to 60% humidity are recommended. Laminar flow is preferable.

Equipment and Supplies

Equipment numbers and types are decided based on the existing standards of the country and the type of services provided.

There should be a functional system in place to ensure the safe and accurate functioning of the machines and equipment. Periodically, the monitors have to be calibrated.

Basic equipment needed to organize a level III ICU is as follows:

- Ventilators, at least one per bed, with at least 40% of the ventilators having built-in noninvasive ventilation capability
- Noninvasive ventilators
- Multichannel monitor with at least two pressure monitoring devices
- Defibrillators and pacemakers
- Infusion pumps/syringe pumps, at least four to eight per bed
- Fluid and bed warmers
- Portable transfer monitors
- Portable ventilators (at least one)
- Specialized beds
- Bedside trolleys, drug cart, and emergency cart
- Patient-lifting devices
- Portable X-ray machine a
- Picture Archiving and Communication system is preferable
- Bedside ultrasound and echo machines
- Renal replacement therapy
- IABP or ventricular assist device
- Bedside bronchoscopy machines

For every patient, the following monitors should be available:

- ECG monitor
- Pressure monitor
- Temperature monitor
- End-tidal CO_2 monitor
- Pulse oximeter
- Noninvasive arterial pressure monitoring
- Bedside arterial blood gas (ABG) lab and ECMO are optional and may be available (see Fig. 63-2).
- For safe handling and maintenance of equipment the medical, nursing, and other allied health personnel have to be trained periodically,.
- Various sizes of endotracheal (ET) tubes, tracheostomy tubes, nasogastric tubes, different types of airways, suction tips, and ICD tubes should be available.
- Catheters, ECG leads, gloves, gowns, masks, goggles, drugs, IV fluids, and refrigerator should be available to store medications.
- Adequate amount of supplies may be stored at the bedside as well as in the central stores.



Figure 63-2 • Extracorporeal membrane oxygenator (ECMO) and ventilator.

Organization of Human Resources

Manpower requirements again depend on the number of patients and the type of patients nursed. The unit has to be headed by the intensive care–qualified consultant.

Critical Care Medical Team

- Head of critical care medicine or Director, who will manage the unit
- Critical care medicine consultant
- Intensive care medicine specialist
- Other specialists
- Residents or critical care medicine fellowship trainees
- Junior medical officer

The Critical Care Nursing Team

- Critical care specialized nurse manager of the unit
- Senior charge nurses with critical care training
- Full-time critical care nurse educator, 1 for every 50 ICU nurses, to take care of the teaching and training needs of the registered nurses
- Nurse:patient ratio: Registered nurses in the ratio of 1:1 for ventilated patients, 1:2 for nonventilated patients, and 2:1 for patients on ECMO support
- Preferable to have more than half of the total strength of nurses to have specialized training after the RN qualification

Other Personnel

These include the following:

- Respiratory therapist
- Physiotherapist
- ICU technician
- Dietician
- Clinical pharmacist
- Radiographer
- Computer operator and receptionist
- Biomedical engineer
- Hospital attendant, 2 in each shift for the first and second shifts, and 1 in night shift for every 10 ICU beds
- Sanitary attendant, 2 in each shift for the first and second shifts, and 1 in night shift for every 10 ICU beds
- Security guards to cover 24 hours

Protocols and Policies of a Critical Care Unit

Critical care is becoming increasingly complex and challenging. The multitude of patient safety problems and unexpected outcomes that arise while applying the advanced technology and the intricate nature of the critical ailments necessitate development of a standardized way of managing the patients. Clinical protocols, guidelines, and care bundles are developed to achieve quality patient care in ICUs.

Protocol is a set of written rules or precisely delineated steps usually developed and tested by well-controlled clinical research for desired clinical outcome. Stress ulcer prevention protocol, deep vein thrombosis prevention protocol, sedation interruption protocol, weaning protocol, oral hygiene protocol, basic life support (BLS) protocol, and advanced cardiac life support (ACLS) protocol are some of the successfully implemented protocols in the ICUs. Checklists facilitate consistent application of protocol. By applying protocol, the similar types of patients are treated in the same way to achieve the same outcome by avoiding omission or commission errors. Protocols also facilitate clinical reasoning and appropriate decision making (Chang, Sevransky, & Martin, et al., 2012). Major disadvantages of protocols are that they are too rigid and do not allow patient-centered care (PCC).

Critical care bundles are another type of tools for implementing standardized care. Care bundles are a group of evidence-based interventions directed to achieve the desired goals such as ventilator-associated pneumonia (VAP) prevention bundle, catheter-associated urinary tract infection (CAUTI) prevention bundle, and delirium prevention bundle.

Guidelines are written policy statements. They help in smooth functioning of the unit and avoid confusions in delivery of care. In level III critical care units, various policies are followed, which include the following:

- Admission policy
- Discharge policy
- Organ donation policy
- Treatment policy
- End-of-life care policy

Quality Indicators of Critical Care

Providing quality care is the essential responsibility of the entire critical care unit team including its head. Earlier, the mortality in the ICU was considered a major quality benchmark. Certainly, the mortality rate has a large bearing on the care provided in an ICU. The ISCCM and hospital accrediting agencies put forth a set of benchmarks to assess and improve the quality of care on a continuous basis. Various categories and the quality indicators delineated by the ISCCM (Ray, Samaddar, Todi, et al., 2009) are given in Table 63-1.

Hospital-Acquired Infection in Critical Care Units

Hospital-acquired infection (HAI) is considered as a safety threat by the patients as well as the healthcare provider. Every member of the healthcare team is held accountable for this preventable medical error (Labeau, Blot, Rello, et al., 2010). Nosocomial infection or HAI can be defined as any newly acquired infection that arises after 48 hours of admission to the hospital.

HAI increases the cost of care, length of ICU stay, and hospital stay, and diminishes the favorable outcome of care. Nurses play a major role in infection control in the critical care unit. Simple nursing interventions such as elevating the head end to 30° to 45° have shown to reduce the most serious HAI, the VAP, that occurs in critical care unit.

Critical care units are the seat of many HAI because of two reasons; the first one is that the number of invasive procedures occurring in the critical care units is more and, second, the critical nature of illness renders the patient susceptible to nosocomial infections. Four major types of HAI occurring in critical care units are the following:

1. VAP
2. CAUTI
3. Central catheter-related bloodstream infection (CRBSI)
4. Surgical site infection (SSI)

Sources

- ICU environment, the ventilators, monitors, floors, and doorknobs, which may harbor some notorious infectious agents

TABLE 63-1 Quality Indicators of Critical Care

Category	Quality Indicators
Outcome indicators	Standardized mortality rate Morbidity indicators • Iatrogenic pneumothorax • Incidence of renal failure in noncoronary patients • Incidence of pressure ulcer • Incidence of VAP • Incidence rate of CLABSI
Process	Length of ICU stay Compliance to various protocols • Hand hygiene compliance • Prevention of CAUTI • VAP prevention bundle • CRBSI prevention bundle ICU readmission rate
Patient safety	Patient falls Medication error Adverse events Needlestick injury Accidental unplanned extubation Reintubation rate
Human resource	Employee satisfaction Absenteeism/turnover
Consumer satisfaction	Patient satisfaction Family satisfaction

CAUTI, catheter-associated urinary tract infection; CLABSI, central line–associated bloodstream infection; CRBSI, catheter-related bloodstream infection; ICU, intensive care unit; VAP, ventilator-associated pneumonia.

- Possibility of some organisms being harbored by patients themselves, which may be transmitted endogenously to elsewhere
- Other patients
- Healthcare professionals
- Visitors

Risk Factors

- Acuity of illness
- Physiological stress response
- Too many invasive procedures and lines in situ
- Malnutrition
- Comorbidities
- Antibiotic abuse
- Immobilization
- Immunocompromised state
- Other external factors such as understaffing and breach in implementation of infection control protocols

Ventilator-Associated Pneumonia

VAP is one of the serious infections occurring in ICU. It is defined as pneumonia that occurs 48 hours or more after ET intubation or tracheostomy, caused by infectious agents not present or incubating at the time when mechanical ventilation was started (Ranjan, Chaudhary, Chaudhry, et al., 2014). In the United States, VAP rate of 4 to 14 days/1,000 ventilated days was reported, whereas in the Indian population, it was reported to be 31.7/1,000 ventilated days. The overall mortality rate in those with VAP was much higher compared with in those in the non-VAP group with 48.33% versus 20%, respectively (Ranjan et al., 2014).

Pathophysiology

The artificial airway introduced into the respiratory tract negates the protective reflexes such as gag reflex, coughing reflex, humidification, and filtering of air available to the patient. Aspiration of the pooled secretion above the inflated cuff and gastric content from the Ryles tube leads to colonization of the lower airway and results in pneumonia.

The pathophysiology of VAP is illustrated in Figure 63-3.

Clinical Features

- Newly occurring infiltration on lung fields in the chest X-ray
- Fever
- Leukocytosis/leukopenia
- Purulent tracheal secretion
- Positive culture for tracheal aspirate

Prevention

The recommended VAP prevention bundle is as follows. P (Gunasekera and Gatrix, 2016; Boltey, Yasusheva, & Costa, 2017).

- Keep head end of the bed elevated at 30° to 45° to prevent aspiration of gastric content and gastric reflux.
- Provide oral care with chlorhexidine solution of strength 0.12% twice or thrice as per unit protocol. The oral cavity colonization can be reduced with the usage of chlorhexidine and regular oral cavity assessment.
- Reduce the duration of intubation through early weaning protocol using daily sedation vacation and spontaneous breathing trial.
- Reduce unplanned extubation and reintubation.
- Institute gastric ulcer prophylaxis.
- Monitor ET tube cuff pressure and maintain it >20 but <30 mmHg to avoid entry of bacterial pathogens into the lower respiratory tract without causing tracheal necrosis.
- Avoid pooling of secretion above the cuff by periodic suctioning through the subglottic port. See Figure 63-4 showing the conventional ET tube and ET tube with subglottic suctioning port.

Catheter-Related Bloodstream Infection or Central Line–Associated Bloodstream Infection (CLABSI)

CLABSI is the most serious HAI. It is preventable through complete adherence to aseptic protocols, surveillance, and management measures.

Definition

CLABSI is a laboratory-confirmed bloodstream infection (unrelated to an infection elsewhere) in which central line is in place within 48 hours before the development of the bloodstream infection (Haddadin and Regunath, 2017).

CRBSI is defined as the bloodstream infection fulfilling at least one of the three criteria stated below. Same organism has grown in the quantitative blood culture drawn through the central line and the peripheral vein with colony count three times higher in the central line culture

- Same organism extracted from the percutaneous blood culture and the catheter tip

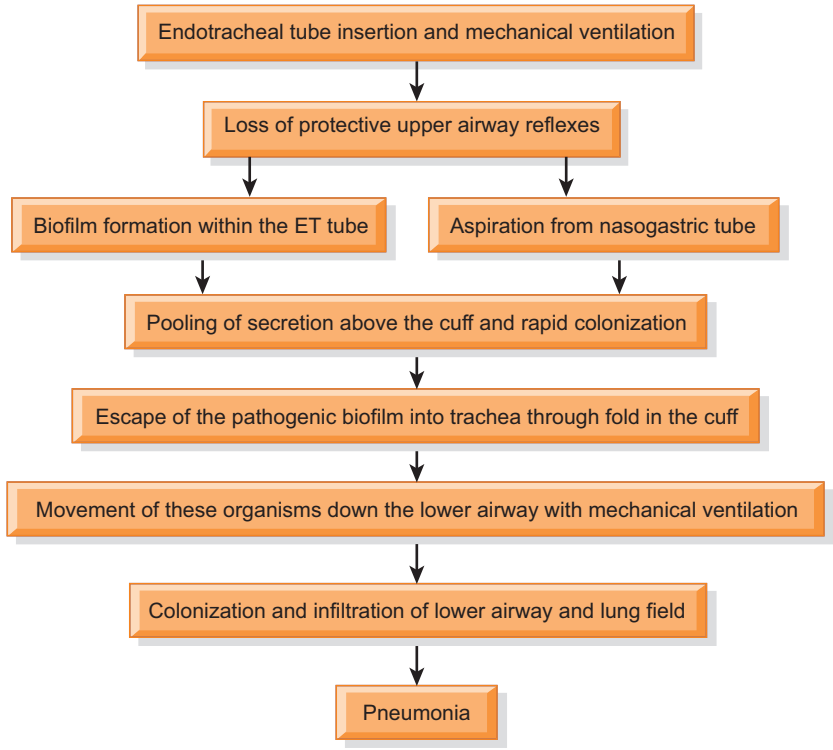


Figure 63-3 • Pathophysiology of ventilator-associated pneumonia.

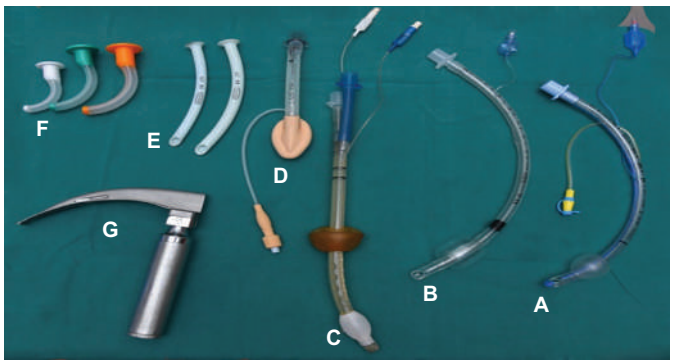


Figure 63-4 • **A**. ET tube with subglottic suctioning port; **B**. regular ET tube; **C**. Combitube; **D**. laryngeal mask airway; **E**. nasal airway; **F**. oral airway; and **G**. laryngoscope.

- Shorter time to positive culture from the central line sample than from the peripheral line sample (>2 hours earlier)

Causes

The following are some common causative organisms:

- Coagulase-negative staphylococci
- Enterococci (vancomycin-resistant enterococci)
- MRSA-positive *Staphylococcus aureus*
- *Klebsiella*
- *Pseudomonas*
- *Aceinetobacter*
- *E. coli*

Risk Factors Present in the Host

- Immunocompromised state—neutropenia, diabetes mellitus, and bone marrow transplant or organ transplant recipient
- Prolonged hospitalization before catheter insertion
- Total parenteral nutrition and dialysis
- Chronic illnesses
- Extremes of age
- Burns and other skin pathology

Pathophysiology

The most important factors causing the CLABSI are as follows:

1. Breach in aseptic precaution at the time of insertion
2. Hub contamination through breach in aseptic handling of catheter
3. Infusing contaminated fluids (rare)
4. Migration of organism from the contaminated skin through the exit point around the lumen of catheter

The tunneled and non-tunneled central venous catheters are available. Tunneled catheters enter through the subcutaneous tissue and the cuff in the catheter prevents entry of microbes beyond that point. In the non-tunneled catheter, the bacteria found on the skin migrate along the catheter from the skin exit point and enter the blood vessel causing colonization and infection. Improper hub manipulation causing breach in the aseptic precautions leads to intraluminal spread of infection. Another mechanism of intraluminal spread is infusing contaminated fluid. Femoral catheter insertion, especially in obese patients, causes extraluminal spread of fungal infection more easily (Haddadin and Regunath, 2017).

Clinical Manifestations

- Fever with chills the typical manifestation
- In extremes of age and in patients with neutropenia, presence of altered mental status, hypotension, lethargy, and fatigue
- On local examination, pus or drainage around the exit site
- Redness, induration, and swelling around the insertion site
- Complaint of pain along the course of the vein by the patient
- Poor or no return blood flow from the venous access.

Management

- After taking blood culture, empirical antibiotic therapy may be started.
- On receiving culture report based on the sensitivity, systemic antibiotic therapy should be started and may be given for 2-week duration.
- If CLABSI is proven, the catheter can be removed and tip sent for culture and sensitivity.
- In hemodialysis, topical and systemic antibiotic therapy may be initially attempted.
- In case of tunneled catheter getting infected, it needs to be removed.

Prevention

The Society for Health Care Epidemiology of America and Infectious Diseases Society of America (SHEA/IDSA)–recommended guidelines (Marschall, Mermel, Fakih, et al., 2014) are given as follows:

- **CLABSI/CRBSI prevention:** At the time of central line insertion
  - Perform hand hygiene with soap and water or foam- or alcohol-based gels.
  - Ensure adherence to infection control protocol while central line insertion using a checklist.
  - Use of gloves does not prevent hand hygiene.
  - Avoid using the femoral vein for central venous access in obese adult patients
  - Do not use peripherally inserted CVCs (PICCs) as a strategy to reduce the risk of CLABSI.
  - Use maximum sterile barrier precautions during CVC insertion, which include wearing sterile PPE and draping the whole body with a large sterile sheet.
  - For smooth complication-free internal jugular catheter insertion, use ultrasound guidance.
  - Apply an alcohol based or chlorhexidine antiseptic solution for skin preparation before puncture.
  - Allow the antiseptic solution to dry before making the skin puncture.
- **CLABSI/CRBSI prevention:** Catheter maintenance bundle
  - Maintain appropriate nurse: patient ratio.
  - Before touching the patient and the central venous access, perform hand hygiene.
  - Catheter hubs, needleless connectors, and injection ports need to be disinfected by using sterile swab and 70% alcohol or povidone–iodine/chlorhexidine-based solution before accessing the central line.
  - Apply mechanical friction for no less than 5 seconds before touching any part of tubing, hubs or connectors or ports to reduce contamination.
  - Use the central vascular access to the period most necessary.
  - Remove unwanted extension catheters.
  - Regularly assess the need for central venous access and if not necessary, remove it at the earliest.
  - For non-tunneled catheter, change the soiled dressing at once. If there is gauze dressing, change the dressing with all aseptic precautions once in 2 days. In case of transparent dressing, it can be changed once in 5 to 7 days' time.
  - Blood sets have to be changed in 24 hours' time.
  - IV sets used for infusing lipid emulsion, propofol, need to be changed in 12 hours' time.
  - IV lines can be changed at least within 96 hours.
  - Use antimicrobial locks.

Catheter-Associated Urinary Tract Infection Prevention

The CAUTI is the other most important infection for which nurses are accountable. It is considered preventable and hence the cost incurred on account of it is not reimbursed by third-party payment agencies. Insertion and maintenance of urinary catheter need to be scrupulous. CAUTI bundle consists of insertion bundle and maintenance bundle (Gould, Umscheild, Agarwal, et al., 2017). Detailed account of UTI is given in Chapter 45.

CAUTI Urinary Catheter Insertion Bundle

- Perform hand hygiene immediately before and after insertion or any manipulation of the catheter device or site.
- Ensure that only properly trained persons who know the correct technique of aseptic catheter insertion and maintenance are given this responsibility.
- Insert urinary catheters using aseptic technique and sterile equipment.
- Use sterile gloves, drape, sponges, and an appropriate antiseptic or sterile solution for periurethral cleaning, and a single-use packet of lubricant jelly for insertion.
- Routine use of antiseptic lubricants is not necessary.
- Properly secure indwelling catheters after insertion to prevent movement and urethral traction.
- Consider using the smallest-bore catheter possible, consistent with good drainage, to minimize bladder neck and urethral trauma.

CAUTI—Urinary Catheter Maintenance

- Following aseptic insertion of the urinary catheter, maintain a closed drainage system.
- If breaks in aseptic technique, disconnection, or leakage occur, replace the catheter and collecting system using aseptic technique and sterile equipment.
- Consider using urinary catheter systems with preconnected, sealed catheter–tubing junctions.
- Maintain unobstructed urine flow by the following:
  - Keep the catheter and collecting tube free from kinking.
  - Keep the collecting bag below the level of the bladder at all times.
  - Do not rest the bag on the floor.
- Empty the collecting bag regularly using a separate, clean collecting container for each patient; avoid splashing, and prevent contact of the drainage spigot with the nonsterile collecting container.
- Use standard precautions, including the use of gloves and gown as appropriate, during any manipulation of the catheter or collecting system.
- Changing indwelling catheters or drainage bags at routine, fixed intervals is not recommended. Rather, it is suggested to change catheters and drainage bags based on clinical indications such as infection, obstruction, or when the closed system is compromised.
- Unless clinical indications exist (e.g., in patients with bacteriuria on catheter removal posturological surgery), do not use systemic antimicrobials routinely to prevent CAUTI in patients requiring either short- or long-term catheterization.
- Do not clean the periurethral area with antiseptics to prevent CAUTI while the catheter is in place. Routine hygiene (e.g., cleansing of the meatus during daily bathing) is appropriate.

- Unless obstruction is anticipated (e.g., as might occur with bleeding after prostatic or bladder surgery), bladder irrigation is not recommended.

Infection Control in ICU

Infection control measures include the general measures and specific preventive measures for selected infections. General measures aim at prevention of all types of HAI in the ICU.

General Measures for Infection Control

1. **Early identification and isolation of patients with signs of infection:**
   - Perform vigilant and continuous monitoring of all critically ill patients for early signs of infections such as leukocytosis, diarrhea, skin rashes, fever, known carrier of pathogenic bacteria, and neutropenia (Mehta, Gupta, Todi, et al., 2014).
   - Identify those with evidence of infections at an early stage and isolate (symptomatic isolation).
   - For those with neutropenia, follow reverse isolation to protect the patients from acquiring infection from others.
2. **Strict adherence of standard precautions:** Standard precautions should be followed to prevent the transmission of blood-borne pathogens. The basic assumption of standard precaution is that every patient handled in the healthcare facility may be potentially harboring blood-borne pathogens. The standard precautions include the following:
   - Minimize contact with the blood, body secretions, and patient care areas.
   - Adhere to strict hand hygiene before touching the patient, after touching the patient, before any sterile procedure, in between long personal care activities, after handing the drainage systems, etc., and also after removing the gloves, before leaving the ICU.
     - See Figure 63-5 for five moments of hand hygiene.
   - Wear personal protective equipment. According to the procedure and the expected mode of contamination wear personal protective equipment namely glove, gown, mask and goggles. Wear gloves during blood or other specimen collections. In case flash of body fluid is expected as during a tracheal suctioning procedure, wear mask, gown, and goggles along with gloves.
   - Appropriately handle equipment and linen used for patient care.
   - Perform appropriate biomedical waste management through segregation of waste at the site of generation and proper disposal as per protocol.
   - Prevent needlestick/sharp injuries.
   - Perform appropriate spill management and environmental cleaning.
3. **Biomedical waste disposal:**
   - There should be strict adherence to segregation of waste at the point of generation and disposal of waste as per the biomedical waste management protocol.
   - All laboratory specimens should be packed in spillage-free container and transported at the earliest.
   - Specimens taken from patients known to harbor HBV, HCV, and HIV are to be labeled with biohazard symbol and sent separately.
4. **Disinfection and cleaning of instrument and linen:**
   - Used contaminated instruments such as bronchoscopes and endoscopes can be cleaned thoroughly and dried before immersing in chemical disinfectants. It is preferable to use 2% gluteraldehyde for more than 20 minutes.
   - Linens contaminated visibly with blood and body fluids need to be treated with 2% sodium hypochlorite

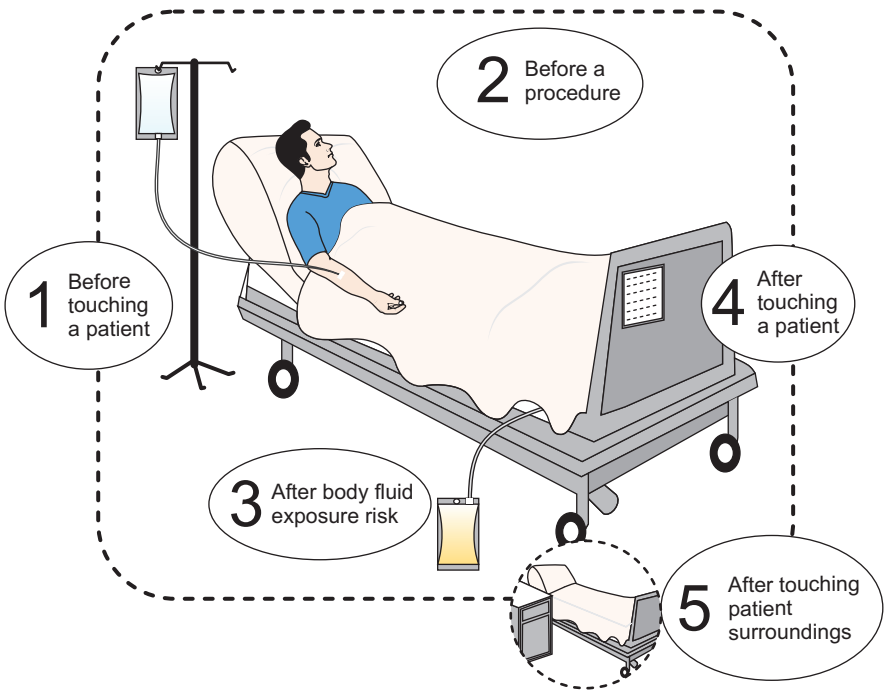


Figure 63-5 • Five movements of hand hygiene.

solution before further cleaning and sterilization to kill the blood-borne pathogen.

5. **Maintenance of ICU environment:** The surfaces wherever frequent contacts or contamination is expected such as door knobs, bed surfaces, and side rails require frequent thorough cleaning with detergent followed by disinfection recommended at least twice a day.
   - Floor cleaning more than once a day is needed.
   - Window sills and exhaust vents have to be cleaned using detergent-impregnated cloth or mop head.
   - Terminal disinfection on death or discharge/transfer of the patient has to be thorough enough to clean and disinfect all the items used.
   - There should be restriction of street clothes for all visitors and healthcare professionals.
   - There should be provision for hand hygiene at the entrance of the critical care unit.
   - It is desirable to have automated doors with sensors fitted on the doors.
   - There should be provision of alcohol-based hand rubs at each bed side.
   - Properly disinfect blood spills or body fluid spills on the floor. Treat the area with sodium hypochlorite solution followed by routine cleaning of floors.
6. **Training and education of all healthcare workers:** Hand hygiene and other infection control policies need to be oriented to all new employees and periodical refresher course on infection control is essential to implement the infection control program effectively.
7. **Antibiotic stewardship:** Antibiotic abuse will lead to development of antibiotic-resistant strains. Follow institutional policy for effective antibiotic use. Nurse's role is to follow correct schedule at the appropriate time.
8. **Institute an active infection control committee** and appropriate infection control surveillance.

Specific Preventive Measures

Certain airborne infectious agents spread through droplets; nuclei measuring more than 5 μm that are expelled into air during coughing and sneezing and can spread infection to susceptible patients or healthcare providers. Similarly, certain infections spread through direct contact. Specific measures need to be instituted to address such infectious microbes.

Airborne/Droplet Protection

- Patients harboring agents that spread through air droplets such as *Mycobacterium tuberculosis*, *Haemophilus influenzae*, *Neisseria meningitidis*, and *Mycoplasma pneumoniae* have to be isolated in a private room.
- The room has to have glass partition and tight doors for sealing of air. The isolation room should have negative-pressure ventilation.
- Visitors and care providers have to wear N95 respirator mask, which is capable of protecting both small and large particles. The mask has to be worn snuggly around the mouth and nose before entering the patient's room.
- Limit the movement of patients.

Contact Precautions

Some organisms that spread through direct contact with an infected patient or indirect contact, that is, through the personal care items. herpes zoster, rotavirus, and hepatitis A virus, can spread through direct and indirect contact. To prevent the spread of such organisms, the following measures need to be followed:

- Isolate the patient.
- Avoid use of equipment and patient care items of other patients.
- In unavoidable circumstances, proper disinfection of the items should be done.
- Limit the movement of patients.

Assessment of Critical Illness in General Medical-Surgical Wards

Before the occurrence of a catastrophic event such as a cardiopulmonary arrest, there are predictable changes in vital parameters many hours earlier (Franklin & Mathew, 1994). If the vital signs are observed carefully, recognizing and instituting prompt treatment of evolving critical illness is possible (Frost & Wise, 2007). These simple clinical parameters are easy to observe and can be assessed clinically. General medical-surgical unit staff can often miss the opportunity to identify the critical illness because of lack of time, overburdened staff, and lack of systematic approach in assessment (Frost & Wise, 2007).

Physiological alterations that occur prior to critical illness or a cardiopulmonary arrest are hypotension, tachycardia or bradycardia, altered respiratory rate (RR), labored breathing, reduced urine output, and new changes in neurological status. Subbe et al. (2001) have developed and validated a system of early earning scoring with five parameters, namely, systolic blood pressure, RR, heart rate, temperature, and neurological status, using AVPU score. In the AVPU scoring system:

- A: Alert
- V: Verbal response positive
- P: Painful stimuli positive
- U: Unresponsive for all stimuli

Different modified early warning scoring (MEWS) systems have been developed with inclusion of SpO_2, urine output, and O_2 therapy (Xu, Tam, Thabane, et al., 2015). The important advantage of early warning systems or MEWS is that early identification and intervention improves outcome from critical illness. In the United States, the United Kingdom, Spain, Singapore, Israel, Australia, India, and other countries, some early warning scoring system has been adopted to predict critical illness early. A team of more experienced ICU health team members is formed as Rapid Response Team (RRT) has now become a common practice in many multispecialty medical centers. The nurse in the general ward can alert the RRT if there is any high-risk MEWS score. The team will assess the patient to decide on the further course of action such as transfer to ICU and definitive care in ICU or more close observation and conservative measures (see Fig. 63-6). Whenever alteration in vital signs is observed by the general ward nurses, they can alert the RRT and can initiate measures such as airway management, oxygen administration, and establishing a venous access. Application of MEWS can help nurses to identify deterioration of those patients who are recently transferred from the ICUs.

Assessment of Critically Ill Patients in the ICU

Assessment of critically ill patients is a challenging task that requires critical thinking, competence, and accuracy. A

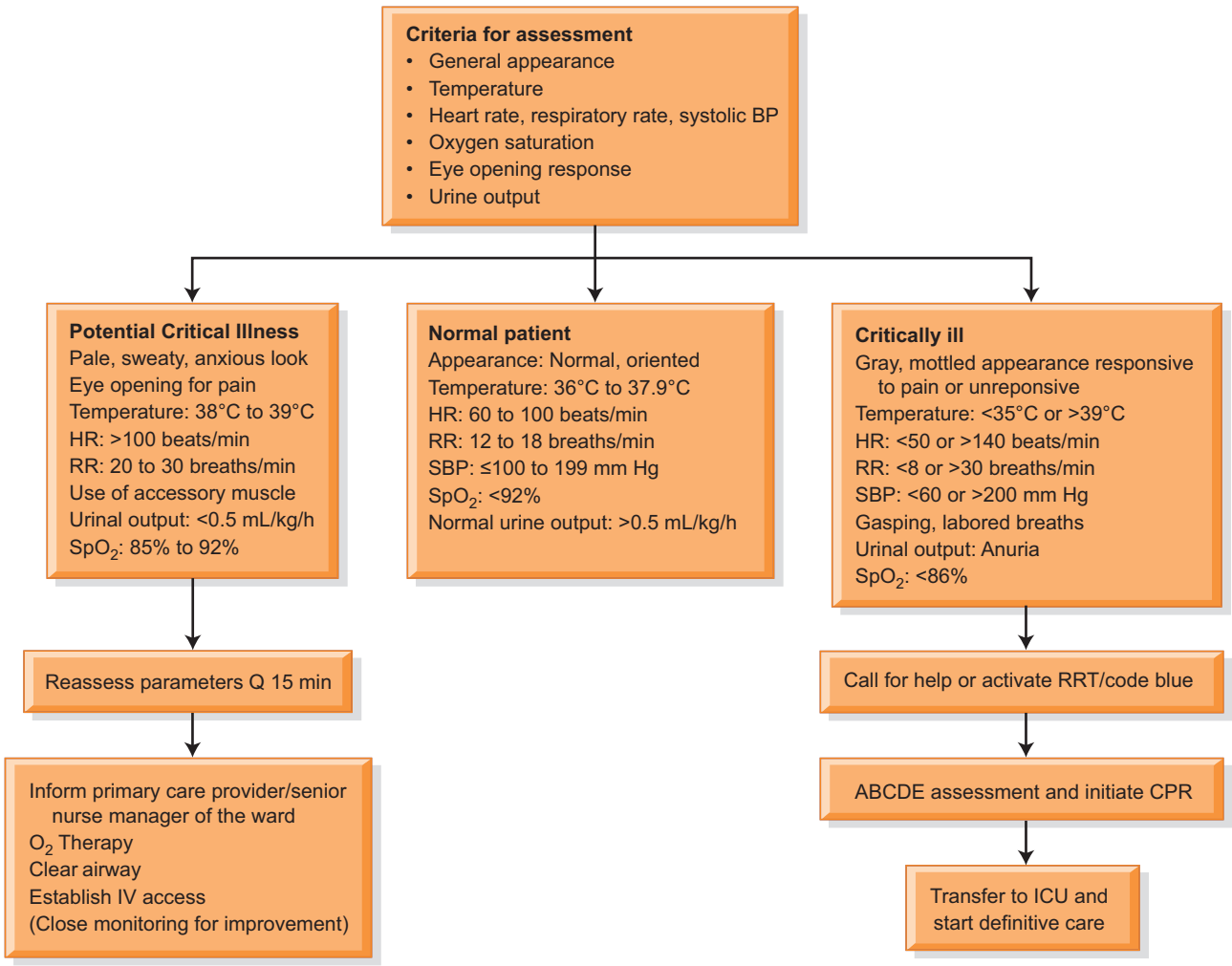


Figure 63-6 • Nurses' guide for early recognition of critical illness in general medical-surgical ward patients. Adapted from Frost, P., & Wise, M. P. (2007). Recognition and early management of critically ill ward patient. British Journal of Hospital Medicine, 68(10), M180–M183; Subbe, C. P., Kruger, M., Rutherford, P., & Gemmel, L. (2001). Validation of a modified early warning score of medical admissions. Quarterly Journal of Medicine, 94, 521–526.

significant difference in assessment of the critically ill and routine nursing assessment is that it is a nonlinear spiral approach where the assessment and management go hand in hand and revisit the steps of primary survey for further planning for management. Patients may be received directly from the ED.

The first step is to enquire from the patient the following: How are you? Or what is your name? Or what happened?

If the patient could answer properly, it can be inferred that his or her airway, breathing, and cerebral perfusion are alright. If the patient is unresponsive, it indicates critical ailment and needs quick assessment and intervention.

If the patient is unconscious and unresponsive, and is not breathing normally (occasional gasps are not normal), start cardiopulmonary resuscitation (CPR) according to the resuscitation guidelines which is discussed in the subsequent section of this chapter. See Table 63-2 for further details on initial assessment of critically ill.

Initial Assessment Using ABCDE Approach

The acronym represents the following:

- A: Airway
- B: Breathing
- C: Circulation
- D: Disability or neurological deficits
- E: Environmental exposure

Secondary Survey

When primary survey is completed with simultaneous resuscitation, secondary survey has to be carried out. It consists of the following:

- Relevant history
- Thorough head-to-toe examination
- Reassessment of ABCDE and vitals
- Blood test
  - Complete blood count
  - Serum electrolytes
  - Blood glucose, urea, and creatinine
  - Bleeding time (BT), clotting time (CT), and partial thromboplastin time (PTT)
  - Liver function tests
  - Serum amylase
  - ABO grouping and cross-matching
  - Toxicology screening
  - ABG analysis

TABLE 63-2 Initial Assessment and Concurrent Management of Critically Ill

	Assessment	Management
Airway	• Look, listen, and feel for obstruction • Seesaw respiration of chest and abdominal muscles that indicates airway obstruction • Noisy respiration indicates partial obstruction • Stridor, rattling noise indicate secretion clogging the airway • No breath sounds indicate complete obstruction • Feel for air movement with your hand closer to the mouth	• Secure the cervical spine in case of suspected injury with a hard collar • Open airway using head-tilt/chin-lift maneuver or jaw-thrust maneuver in suspected cervical injury • Clear foreign body if any using finger sweep technique • Apply oropharyngeal suction • Insert oral airway or, if needed, endotracheal airway
Breathing	• Look for bilateral chest movements • In case of pneumothorax, sucking of chest wall may be present • Check respiratory rate and rhythm; RR <8 or >25 breaths/min indicates ventilation problems • Listen for the breath sounds, crackles, wheeze, etc. • Observe for cyanosis or mottled skin appearance; indicates poor oxygenation • Check the oxygen saturation using a pulse oximeter	• Administer high-concentration oxygen • In case of COPD, lower concentration of oxygen using venturi mask may be administered (2 to 3 L/min) • If all these measures are failed, administer O_2 through NIV or mechanical ventilator • In case of suspected pneumothorax or hemothorax, insertion of intercostal drainage tube may be necessary
Circulation	• Observe the color of the digits, as well as the oral mucosa, lips for peripheral and central cyanosis • Assess the pulse rate, rhythm; <60 or >120/min indicates compromised circulation • Barely palpable carotid pulses suggest a poor cardiac output, while a bounding pulse may indicate sepsis • Feel for peripheral warmth. Cool and clammy extremity indicates poor cardiac output • Assess the urine output by passing a urinary catheter. If it is <0.5 mL/kg/h, it indicates poor cardiac output • Check the blood pressure. Low BP with collapsed central veins indicates circulatory compromise • Auscultate for the heart sound; crackles indicate pulmonary edema • Observe for internal or external blood loss • Assess the ECG pattern	• Insert a large-bore needle and send blood for investigations including grouping and cross-matching • Connect the patient to continuous ECG monitor and BP monitor • Replace the lost fluid volume • If the cause of compromised circulation is cardiac with presence of dyspnea, crackles, and increased JVP, do not force fluid. Instead, start inotropic agents In those patients with chest pain, start nitroglycerine and ACS management If there is internal or external bleeding, prepare the patient for eventual surgical intervention to arrest bleeding
Disability or neurological status	• Review ABC • Assess the level of consciousness using GCS and pupillary reaction • Assess AVPU, where A, *a*lert/eye opening; response to *v*erbal stimuli/for *p*ain only/U, *u*nresponsive • Check blood glucose values to rule out hypoglycemia or hyperglycemia • Check for sedative medications • Identify and check for consumption of poison/drug • Check for traumatic brain injury	• Correct the derangements in ABC • Nurse the patient with head-end elevated position • Correct hypoglycemia with 10% dextrose or inj. glucagon
Exposure	• Complete assessment including the back for injury with total body exposed after ensuring complete privacy and dignity • Assess the temperature for hypothermia	• Maintain body temperature with blanket or warmer

ACS, acute coronary syndrome; BP, blood pressure; COPD, chronic obstructive pulmonary disorder; ECG, electrocardiogram; GCS, Glasgow coma scale; JVP, jugular venous pressure; NIV, noninvasive ventilation; RR, respiratory rate.

- X-rays
- ECG
- Echo/ultrasound
- CT/MRI

History

Pertinent history includes allergies, medications, present and past history, pregnancy if woman of child-bearing age, last meal time, events, and the environment where the critical event happened.

When the patient is transferred into the ICU from ED after complete stabilization or from OR, the nurse taking charge of the patient should collect all the details from the ED or OR nurse. It can be summarized by the pneumonic ISBAR:

- *I*: **Identifying details**, that is, name and gender
- *S*: **Situation warranted admission**
  - Mechanism of injury
  - Chief complaints
  - Loss of consciousness if any, and duration
  - GCS score at the time of admission/injury
  - Completed blood tests with the results
  - Diagnostic procedures and treatment carried out
  - Medications administered, especially the opioid analgesics or sedatives
- *B*: **Background details**
  - Significant past medical and surgical history
  - Home medications

- *A*: **Assessment details**
  - Current vitals
  - Current GCS
  - Pupillary assessment
  - Airway and ventilator settings
  - Fluid status: Intake and output
  - Other major findings
  - Family members' level of coping and understanding about the patient's condition and treatment
- *R*: **Recommendation**
  - Plan of care
  - Fluid volume to be administered
    - Recommended blood and blood products (if any)
  - Inotropic agent and medications being infused or advised

Monitoring Patients With Critical Illness

Proactive monitoring on the part of the nurses for early identification and management of complications ensures patient safety and enhances quality of care delivered in critical care unit.

Critical care nurse should monitor the following parameters periodically:

- Vital signs: Pulse, RR, temperature, and blood pressure
- Peripheral pulse and warmth to assess cardiac adequacy
- Verbal pain assessment in patients who can vocalize and nonverbal pain assessment in those who cannot speak
- Continuous ECG monitoring and oxygen saturation (SpO_2)
- Hourly intake and output chart
- GCS and pupillary response
- Mini-Mental Status Examination
- Muscle power and reflexes
- Hemodynamic parameters
- Monitor the following ventilator parameters
  - The mode of ventilation, set parameters such as tidal volume, FiO_2, pressure support, RR, PEEP, I:E ratio, minute ventilation, peak airway pressure, sensitivity triggers, and alarm settings.
  - Check that appropriate alarm setting are kept.
  - Check the humidifier is not filled with condensed water vapor.
  - Ensure the lip level is marked on the chart at the time of intubation and monitored frequently to ascertain that the ET tube has not slide down beyond carina
  - Check the cuff pressure
- Check for bilateral air entry through chest movements and auscultations.
- ABG analysis
- Nutritional status of the patient and nutritional need
- Communication status of patient
- Psychological issues of patient such as anxiety, depression, and fear
- Pressure ulcer risk using risk assessment scales such as Braden scale
- Second-hourly skin checks over the bony prominences to prevent pressure ulcer development
- Assess frequently for the hygienic needs, presence of soiled linen,

Hemodynamic Monitoring

Continuous arterial pressure monitoring, central venous pressure, and pulmonary artery pressure monitoring play a vital role in appropriate management of patient. See Table 63-3 for the clinical significance and normal values of the hemodynamic parameters.

Parts of Hemodynamic Monitoring System

- An invasive catheter and high-pressure tubing that connect the patient to the transducer
- The transducer that converts the physiological signal from the patient into electrical signals
- The flushing system that maintains the patency of the fluid-filled tubing and catheter
- A bedside monitor that receives electrical energy from the transducer and displays it in waveform and in digital scale

Nursing Alerts in Hemodynamic Monitoring

- Calibrate the equipment periodically for accurate hemodynamic measurements at the start of every shift.
- Maintain the phlebostatic axis for accurate measurement. It means that the transducer is kept at a height that corresponds to the left atrial level.

TABLE 63-3 Clinical Significance of Various Hemodynamic Parameters

Hemodynamic Parameter	Significance	Normal Values
Mean arterial pressure (MAP)	Average blood pressure created in the cardiac cycle	70 to 100 mmHg
Central venous pressure (CVP)	Pressure in the central vein and it is equal to the pressure in the right atrium that indicates circulating fluid volume. High value indicates circulatory overload	2 to 5 mmHg or 3 to 8 cm H_2O
• Pulmonary artery (PA) pressure—blood pressure exerted in pulmonary artery using the indwelling catheter • Pulmonary capillary wedge pressure (PCWP)—pressure exerted in the left side of the heart when the pulmonary arteriole is occluded using an inflated balloon present in pulmonary artery wedge port	• Increased pulmonary artery pressure shows that the pulmonary vasculature is narrowed, leading to increased resistance • Pulmonary hypertension can lead to heart failure and increase the workload of the heart • Nursing alert while checking PCWP • Deflate the balloon as soon as PCWP is recorded. Avoid inflating the balloon often	• PA systolic pressure: 20 to 30 mmHg • PA diastolic pressure: 5 to 10 mmHg • PCWP: 5 to 12 mmHg
Left atrial (LA) pressure	Pressure created by volume of blood present in left atrium when the mitral valve opens. If it increases, the ejection fraction reduces. Commonly measured in post–mitral/aortic valve surgery	5 to 12 mmHg

- Monitor the hemodynamic parameters and record them.
- Compare the hemodynamic waveforms and hemodynamic parameters with other clinical parameters.
- Maintain the appropriate hand hygiene while handling the monitoring system and maintain the closed system all times.
- Maintain the flushing system and the hemodynamic monitoring system and the intravascular catheter free of air or clot.
- Monitor the peripheral pulse, peripheral warmth, and capillary refill distal to the catheter insertion site.
- Maintain sterility of port while handling it for flushing, taking samples for ABG, etc., by cleaning it with alcohol swab and by taking samples aseptically. After taking samples or handling the port, wrap it with a sterile towel.
- Perform sterile dressing changes to the catheter insertion site.
- Inspect the catheter insertion area for signs of infection such as redness, induration, warmth at the site, and fever.
- Prevent air embolism by purging out the air bubbles. Let out the air bubbles from the whole flush solution and system before connecting it.
- Maintain the transducer without getting damped to maintain accurate recording.
- Do not introduce dextrose-containing solution into the monitoring system.

Management of Critically Ill Patients

Critically ill patients often present with impairment in ventilation, oxygenation, and circulation irrespective of the pathophysiological sequence. They may have single-organ or multiorgan dysfunction that needs to be managed simultaneously. Whatever may be the system involvement, they may require intubation and mechanical ventilator support. See Chapter 11 for further details on mechanical ventilation They may also face circulatory collapse. Because of primary brain pathology or secondary to circulatory or respiratory failure, the patient may have loss of consciousness. For the purpose of continuous BP monitoring and to draw samples for ABG analysis, an arterial line may be inserted. Peripheral and central venous access may be established to administer medications and to monitor circulatory status. Urinary catheterization is done to monitor the urine output. The patient may be connected to a continuous ECG monitor.

Nursing Diagnoses

Based on the patient assessment described above the commonly encountered nursing diagnoses in a critically ill patient are as follows:

- Ineffective airway clearance related to diminished gag reflex and/or excessive secretion as evidenced by visible or audible secretion, increased RR, increased airway pressure alarm in ventilated patients, and restlessness
- Impaired gas exchange related to ventilation–perfusion mismatch as evidenced by cyanosis in the oral mucosa, lips, SpO_2 <93%, hypoxemia, hypercapnia, decreased mentation, restlessness, and abnormal RR and rhythm
- Decreased cardiac output–related decreased fluid volume or poor contractility of heart and/or dysrhythmia as evidenced by hypotension, increased or decreased heart rate, feeble peripheral pulse and cool extremities, and urine output <30 mL/h or <0.5 mL/kg/h
- Impaired cerebral tissue perfusion related to increased intracranial pressure (ICP) or CNS depression/CNS infection as evidenced by changes in the level of consciousness, bradycardia, changes in rate and pattern of respiration, changes in the pupillary reflex and size, and shape of pupils
- Self-care deficit (global) related to critical illness and loss of consciousness
- Anxiety related to threat to life and fear of death
- Pain related to tissue damage
- Impaired physical mobility related to changes in the level of consciousness or poor cardiac reserve or increased work of breathing and fatigue or trauma
- Impaired verbal communication related to presence of artificial airway
- Sensory perceptual disturbances related to noisy gadgets, ICU environment, etc.
- Risk for infection related to presence of invasive lines and physiological stress
- Risk for fall related to changes in the level of consciousness.

Airway Management

To maintain patent airways, the following nursing interventions have to be followed:

- Place an oropharyngeal airway to prevent tongue falling back/to prevent biting the ET tube.
- Elevate the head end of the bed 30° to 40° to prevent aspiration of gastric content and gastric reflux.
- If oral secretions are more, apply suctioning using a Yankauer suction tip.
- If the patient is intubated and on ventilator, perform gentle ET suctioning. While introducing, do not apply suction as the suction tip is withdrawn. Apply suction and rotate the tube 360° and complete suction. The duration of suction should be limited to 15 seconds.
- At the end of ET suctioning, oropharyngeal suctioning can be done.
- If secretion is thick, provide nebulization therapy.
- If the patient is on ET tube, mark the lip level and record it and maintain the same to identify and prevent the descent of ET beyond carina.
- Auscultate the breath sounds.
- Provide chest physiotherapy to loosen the secretion.

Gas Exchange and Ventilator Management

- Assess the mode and ventilator parameters, the ventilator connections, and circuits.
- Place the patient in low Fowler's position.
- Monitor that the patient is delivered set tidal volume and pressure.
- Monitor the positive end-expiratory pressure (PEEP).
- Monitor the ABG, SpO_2, and bilateral air entry.
- Set the alarms at the appropriate level.
- Before silencing the alarm, check the reason for alarms and manage appropriately.
- Ensure that the set tidal volume is delivered by inflating the cuff with appropriate pressure (20 to 25 mmHg) using minimal leak or minimal occlusive volume technique so as to prevent air leak or aspiration of pooled secretion.
- As and when required (high airway pressure alarm, patient fighting with ventilator, audible or visible secretion, decrease in SpO_2), perform gentle ET suctioning to keep the airway patent.
- Administer nebulizer as per prescription.

Maintaining Adequate Cardiac Output/ Fluid Management

- Monitor the blood pressure continuously using invasive or noninvasive technique.
- Establish venous access either central or peripheral, and administer normal saline at the prescribed rate.
- Replace electrolytes lost through infusion of IV fluids.
- If there is a blood loss, arrange and transfuse compatible blood.
- In case hypovolemia is not the cause for the decreased cardiac output, do not rush the IV fluids; it may be counterproductive. In such a case, inotropic agent and correction of dysrhythmia are useful.
- Administer inotropic agents such as inj. dopamine, dobutamine, or adrenaline or noradrenaline as per the prescribed dose.
- Monitor the CVP pressure, and check peripheral pulse, peripheral warmth, and urine output hourly.
- Maintain optimum fluid volume.
- Monitor strict intake–output chart. The urine output of 1 mL/kg/h is considered normal. Urine output <0.5 mL/kg/h is critical low.
- If the patient had ACS or dysrhythmia, appropriate prescribed drug therapy may be administered.

Maintenance of Cerebral Tissue Perfusion

- Elevate the head end of the patient at 30° to improve venous return from the head.
- Maintain the head, neck, and body in normal alignment to facilitate venous return.
- Monitor neurological status, vital signs, SpO_2, pupillary signs, and reflexes.
- Maintain patent airway by oropharyngeal or ET suctioning (as indicated).
- Administer the prescribed supplemental oxygen so as to have SpO_2 >95% and avoid hypercapnia that will dilate the cerebral blood vessels and increase ICP.
- Reduce the high-volume alarm sounds so that excessive stimulation is avoided.
- Maintain the blood pressure within normal limit so that appropriate cerebral perfusion pressure is maintained.
- Maintain normothermia. If the patient has hyperthermia, initiate aggressive hypothermia measures to bring back the temperature to normal level as hyperthermia will further aggravate the ICP.
- Administer prescribed anticonvulsants and anti-inflammatory or diuretic agents in case increased intracranial signs and symptoms are present.

Maintenance of Physical Mobility and Prevention of Deep Vein Thrombosis/Pressure Sore

- The patient may be kept on absolute bed rest if the condition warrants such as ACS.
- Encourage bed mobility as much as possible.
- In unconscious patients, provide passive exercise and every second hourly, change the position.
- Apply thromboembolic stockings.
- Observe the skin color over all the bony prominences every second hour at the time of position change. Be alert to identify stage 1 pressure ulcer through purple discoloration.
- Improve comfort in bed.

Pain Management in Critically Ill

Effective pain management in the critically ill not only reduces the length of ICU stay but also improves the quality of care and patient satisfaction. Poorly managed pain during ICU stay leaves fearful experiences for days or even months after ICU discharge. Optimal pain management in critically ill patients is a collaborative responsibility of all members of the critical care team. Prompt assessment, timely intervention, and documentation of the intervention are the keys for successful pain management.

Critically ill patients experience pain during rest, routine ICU procedures, and special procedures (Barr, Fraser, Puntillo, et al., 2013). Verbal self-report of pain is a reliable and easy way of assessing pain. Pain assessment is challenging as critically ill patients are most often on ventilator assistance and unable to communicate. Based on the survey done by Rose et al. (2012), it was clear that majority of nurses did not assess pain among patients who could not communicate verbally, whereas 89% of the nurses were comfortable assessing the verbal pain report of patients. The survey further reports that only fewer nurses were aware of the professional society practice guidelines regarding pain assessment and management.

Society for critical care medicine clinical practice guidelines (Barr et al., 2013) recommend that pain be monitored routinely among all critically ill patients. There are many pain assessment tools available for use in critically ill adult patients such as Adult Nonverbal Pain Scale, Pain Behavior Assessment Tool developed by Punitillo, Behavioral Pain Rating Scale (Payen, Bru, Bosson, et al., 2001), and Critical Care Pain Observation Tool. Critical Care Pain Observation Tool and Behavioral Pain Rating Scale were found to be valid tools for pain assessment in patients who cannot verbally report their pain (Barr, Fraser, Puntillo, et al., 2013) (Arif, Joseph, Grap, et al., 2014). In the Behavioral Pain Scale, facial expression, upper limb movement, and compliance with ventilator are the three areas assessed. The least score is 1 in each area, maximum is 4, and the total score is 3 to 12. Minimum score is 3, which indicates no pain, and maximum score is 12. Scores of 6 and above need an analgesic.

The choice of analgesics varies according to the pain intensity and the intended procedure. The opioid analgesics, namely, fentanyl, morphine, hydromorphone, methadone, and remifentanil, may be used alone or in conjunction with nonopioid analgesics. Pain has to be effectively managed in minor procedures by preemptive analgesics along with nonpharmacological interventions. In mechanically ventilated patients, light sedation, that is, sedation level at which the patient is kept in an arousable state and able to follow simple commands, is recommended. Light sedation among mechanically ventilated patients has been shown to reduce the duration of mechanical ventilation and length of stay in ICU. In patients on mechanical ventilator, benzodiazepine sedatives such as propofol or dexmedetomidine are preferred over benzodiazepine sedatives, namely, midazolam and lorazepam (Barr et al., 2013).

Nonopioid analgesics such as ketamine (IV), acetaminophen/paracetamol (IV/per oral), ketorolac (IV/IM), and ibuprofen (IV/per oral) may be given to reduce the dose of opioid analgesics. To manage pain arising from neurological ailments, opioids along with gabapentin or carbamazepine may be prescribed.

Nutritional Management of Critically Ill Patients

In critically ill patients, the stress response and infections place the patient's nutrition in jeopardy. Prompt nutritional assessment and early management of nutritional needs of critically ill patients in combating the inflammatory response associated with catabolic state are essential for a better outcome. Traditionally, nutritional support is deemed as a

measure of supply of exogenous fuel for the patients. Now it can be considered as an adjunct therapy aimed at mitigating the devastating effect of metabolic and inflammatory response associated with critical ailments (McClave, Taylor, Martindale, et al., 2016). To prevent loss of excessive lean body mass and to limit the oxidative stress, more than 1 g/kg body weight of protein is needed (Preiser, Van Zanten, Berger, et al., 2015).

Nutritional assessment should be carried out based on the disease severity, previous nutritional intake, comorbidity, and functional status of GI tract. Critical care nurses play a pivotal role in meeting the nutritional needs by collaborating with other members of the team. Nutritional assessment should be based on the previous food intake, severity of the underlying illness, comorbidities, and the functional status of the GI tract. The evidence-based current guidelines of Society for Critical Care Medicine and American Society for Parenteral and Enteral Nutrition recommend the following (McClave et al., 2016):

- Enteral nutrition is preferred over parenteral nutrition and should be initiated as early as 24 to 72 hours following admission or onset of a major critical illness.
- Among patients with hemodynamic instability, after completing the resuscitation, enteral nutrition should be started.
- Regardless of the presence of bowel sounds or passage of flatus or stool, enteral feeding is recommended (McClave et al., 2016).
- In patients with a high risk of aspiration, small bowel feeding is preferred over gastric feedings.
- Continuous enteral feeding is recommended over periodical feeds.
- Whenever the patients are in severe protein–energy malnutrition and enteral feeds are not feasible, parenteral nutrition should be initiated as soon as possible following resuscitation.
- In patients subjected to major GI surgeries for whom enteral feeds are not possible, parenteral nutrition should be initiated.
- The calorie requirement is 25 to 30 kcal/kg/day.
  - The protein requirement is 1.2 to 2.0 g/kg/day.
- Micronutrients and antioxidants are essential to combat infection and to facilitate recovery.
- In obese patients, enteral formulas with less calorie and more protein are recommended.
- In patients with ARDS, specially prepared enteral fluid formulas with very high calorie and with all other micronutrients have to be given in small quantities.

Monitoring Tolerance and Adequacy of Fluid Intake

- On an ongoing basis, nurses need to monitor the adequacy of enteral feeds.
- Monitor the blood glucose levels and maintain between 140 and 180 mg/dL.
- When patients are on parenteral feeds, maintain the flow rate optimally. Too fast administration may lead to hyperglycemia and fluid overload. Similarly, too slow administration of parenteral nutrition may lead to hypoglycemic spells.
- Avoid injecting drugs in the venous access through which the parenteral fluids are administered.
- Ensure that the patients do not aspirate by initiating the monitoring of:
  - Head-end elevation to 30° to 45°
  - Postpyloric feeds
  - Continuous feeds rather than interrupted feeds
  - Prescribed prokinetic drugs such as metolachlor, bromide, and erythromycin, which may be administered in time

Communication in ICU

Communicating With Patients and Their Family Members

Critically ill patients describe impairment in communication as a terrifying experience. Communicating effectively is a significant factor in the assessment of pain and other symptoms and in patients' participation in decision making about treatment in the ICU (Happ, Tuite, Dobbin, et al., 2004). Studies have shown that patient satisfaction and family satisfaction have been shown to be improved with effective communication (Rodriguez, Rowe, Thomas, et al., 2016; Wilson, Haut, & Akintade, 2017).

Barriers in Communicating With Critically Ill Patients

- Impaired cognition
- Patients in delirium
- Sedation
- Altered level of consciousness
- Language barriers
- Educational and cultural variation
- Presence of tracheostomy, or ET tube following head and neck cancer surgery or a stroke or to facilitate mechanical ventilation
- Poor skills of nurses in interpreting nonverbal communication
- Lack of time for nurses to understand nonverbal communication

The American College of Critical Care recommends PCC for improved outcomes in critical care. High-quality nurse–patient interaction is an essential component of PCC (Hobbs, 2009). Based on the PCC model, five domains for effective patient-centered communication were shown to improve the patient and family outcomes (Hobbs, 2009; Slatore, Hansen, Ganzini, et al., 2012). They are as follows:

- *Biopsychosocial perspective*: There should be information exchange and effective and accurate risk communication.
- *Patient as person*: Listen to the patient's worries and concerns, and encourage questions.
- *Shared decision making*: Patients or their surrogates and the clinician have shared responsibility for improved patient outcome.
- *Therapeutic alliance*: Clinician knows the patient's desires and the patient understands care plan.
- *Provider as person*: Know limitations of knowledge and appropriate involvement of other clinicians.

The patient-centered communication is the central component that connects all the five domains identified that ultimately lead to improved patient satisfaction and family satisfaction with care, decreased anxiety and depression, and improved decision making.

Innovative and effective communication techniques are needed for speechless patients.

Methods of Communication by Patients With Problems in Verbal Communication

- Head nods, gestures, and mouthing words
- Paper and pencil writing
- Pictorial communication boards
- Electronic voice output communication aids or a prerecorded human voice aid
- Digitalized computer-generated voice message
- Cuffless fenestrated tracheostomy tubes and Speak-EZ tracheal and talking tracheostomy tube (Morris, Bedon, Mclntosh, et al., 2015)

Chart 63-1 NURSING RESEARCH PROFILE

Innovative Communication Intervention for Speechless Critically Ill Patients

Background: Sudden speechlessness is common in critically ill patients who are intubated or have had surgery for head and neck cancer. Sudden inability to speak poses challenges for hospitalized patients because strategies to facilitate communication are often limited and unreliable.

Objective: The aim is to determine the impact of a technology-based communication intervention on patients' perception of communication difficulty, satisfaction with communication methods, and frustration with communication.

Methods: A quasi experimental, four-cohort (control and intervention) repeated-measures design was used. Data were collected daily for up to 10 days. Patients in adult critical care units were followed up as they were transferred to other units within the institutions selected for the study. The impact of a technology-based communication system (intervention) was compared with that of usual care (control). Patients' communication outcomes pertinent to communication with nursing staff that were evaluated included perception of communication ease, satisfaction with methods used for communication, and frustration with communication.

Results: Compared with participants in the control group, participants in the intervention group reported lower mean frustration levels (−2.68; SE, 0.17; 95% CI, −3.02 to −2.34; $P < 0.001$) and higher mean satisfaction levels (0.59; SE, 0.16; 95% CI, 0.27 to 0.91; $P < 0.001$) with use of the communication intervention. Participants in the intervention group reported a consistent increase in perception of communication ease during the hospital stay.

Conclusions: The results facilitated evaluation of a bedside technology-based communication intervention tailored to the needs of suddenly speechless critically ill patients.

Source: Rodriguez, C. S., Rowe, M., Thomas, L., Shuster, J., Koeppel, B., Cairns, P. (2016). Enhancing the communication of suddenly speechless Critical Care Patients: American Journal of Critical Care, 25(3), 40–47.

A study by Rodriguez et al. (2016) tested and demonstrated the effectiveness of personal tablet computer using a communication software. It was reported that those who used the communication software found less difficulty in communication, less frustration in communication, and a higher mean satisfaction level with their communication method (see Chart 63-1).

Communicating With Other Healthcare Team Members

Critical care is essentially collaborative including communication. Effective flow of communication within the critical care team is imperative for safe and quality care. Timely, accurate, and clear communication is necessary. Apker et al. (2006) recommend **4Cs** for nurses for health team communication. They are as follows:

- *Collaboration*: Collaborate with other team members and participate in patient care decisions.
- *Coordination*: Coordinate with other team members, assign responsibilities, mentor junior nurses and interns, and encourage their inputs.
- *Compassion*: Demonstrate consideration and compassion for other team members.
- *Credibility*: Communicate assertively and clearly.

Tips for Nurse Communication for Safe Care

- Handoff practices should follow some systems such as ISBAR (I, identify; S, situation; B, background; A, assessment; R, recommendations) or RSVP (R, reason; S, story; V, vital parameters; P, plan of care).
- While communicating to physicians, gather all relevant information, changes in the parameters, trends of vital signs, ECG changes, pressure value trends, abnormal lab results, and pertinent history and present them.
- Sensitive information and crucial results should be double checked and clearly communicated, emphasizing the need for immediate attention.
- Double check orders in doubt before carrying them out.
- Correct identification of the patient using name and register number before reporting or recording can prevent errors in care.

Meeting Needs of Family Members of Critically Ill Patients

Having a family member in critical illness is stress provoking. They are overwhelmed with emotions and inability to understand the clinical condition and outcomes often makes them feel incompetent to make healthcare decisions on behalf of the patient. They experience hopelessness, anxiety, and depression. Studies have shown that the family member's posttraumatic stress scores were high among those who felt that the information provided to them was incomplete (McAdam & Puntillo, 2009). Family members of critically ill patients consistently identify the need for information and reassurance as the highest-priority needs during an ICU hospitalization, yet the need for information is often unmet. Schnock et al. (2017) have identified that the family members lack coordinated, consistent, and complete information from the critical care team members while their loved ones were managed in the critical care units. They recommended standard information through a digital learning portal on three basic aspects, namely, the ICU arrival, ICU care, and transition from ICU.

Family Needs

- Communication that maintains hope
- Questions to be answered honestly
- Accurate and consistent information about the patient's condition, possible treatment alternatives, and prognosis
- Timely notifications regarding the changes in the patient's condition
- Visits and time to spend with their loved ones
- Empathetic comfort care

ICU family meetings are associated with beneficial outcomes for patients, patients' families, and healthcare system. Family meetings have to be conducted at the earliest possible and whenever there is change in health status of patients and whenever the need arises to change the course of treatment (see Fig. 63-7). For effective family communication, the following are necessary:

- There should be consensus between the multidisciplinary team.
- Allow open-ended questions from the family members.
- Patiently listen the family members' concerns and questions.

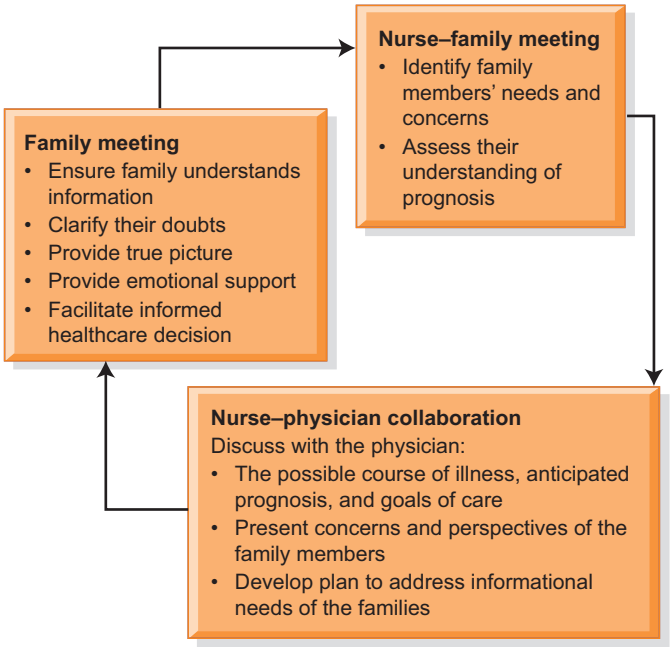


Figure 63-7 • Critical care nurses' role in communication with family members of patient in ICU. Adopted from Milic, Puntillo, Turner, et al., (2015). Communicating with Patients' Families and Physicians about Prognosis and Goals of Care. American Journal of Critical Care, 24(4).

- Reflect the questions to dispel any misconception.
- Understand others' perspectives.
- Show empathy to the expressions.
- Clearly and accurately answer their queries.
- Ensure that family members understand it in the right perspective.
- Show respect and support them throughout the meeting.
- Uphold honesty in communication with the patient as well as other team members.

Transitional Care From ICU

Transitional care includes a set of activities that ensure continuity of care with proper coordination while the patient is transferred between two different levels of care in the same health care setting or different locations (WHO, 2016). The transition from ICU to general medical surgical wards involves a lot of risk as the patients are just out of critical illness and may have still fluctuations in the health status. Transitional care quality is considered as one of the indices that reflects the overall quality of care delivered by the hospital (Hervé, Zucatti, & Lima, 2020).

Inadequate transitional care can lead to lot of serious adverse events such as medication errors, falls, duplication of care or omission of care, deterioration in the clinical status, readmissions to ICU, and cardiac arrest. Eventually it will result in poor patient and family satisfaction. For effective transitional care from ICU, discharge needs to be well planned and comprehensive. A scoping systematic review (Hervé et al., 2020) has shown that poor discharge planning such as discharge at night or weekends is associated with negative outcomes, whereas delayed ICU discharge is associated with the incidence of delirium. Well-planned consensus transfer protocols from ICU, ensuring the availability of logistic arrangements and resources at the transfer destination, are very important for safe transitional care. Patient assessment for discharge readiness from ICU, proper discharge planning, appropriate discharge execution, and postdischarge follow-up are the components of transitional care from ICU.

The holistic structured communication is one of the pillars of effective transitional care. Transfer checklist and structured communication can ensure effective transfer of vital patient clinical information. Medication reconciliation, stabilizing vital signs and reducing the need for ICU care, and discharge to intermediary care unit or step-down ICU are some of the factors that have a positive impact on transitional care (Hervé et al., 2020). Patients and family members need to be reassured when transferring the patient from ICU and educated about their role in the provision of safe-care.

Breaking Bad News

Any news or information about the patient that evokes negative emotions should be considered as bad. It may vary based on the circumstances. Usually, death or information on dying is considered as bad news (Collini, Parker, & Oliver, 2021). Informing the bad news to the patient's family is quite challenging to the health care providers. Death of the patients or futile care is many a time devastating to health team members and they may get burnt out. Additional training is needed to handle people in crisis.

On hearing the bad news, most of the time the relatives may be stunned, or may show disbelief, anger, and grief. Individual patients and their family may prefer to receive the bad news differently based on their cultural beliefs and other personal preferences (Joszt, 2020). Some common principles need to be observed while delivering the bad information. The health care provider needs to ensure privacy and a comforting environment. As much as possible, the health care professional needs to be honest and give accurate information, show empathy, and provide time to accept the bad news. Distressing information needs to be divulged in a systematic manner so that the patient and relatives will get satisfied.

Frameworks for Breaking Bad News

For breaking the bad news, the health care professionals need to develop their skill in interpersonal communication. Role play–based training is shown to improve the confidence level in dealing with such situations for emergency room personnel (Collini et al., 2021).

There are different models proposed and employed. The SPIKES model proposed initially for the use of oncology department by Baile, Buckman, Lenzi, et al. (2000) has been widely used in critical care also. It consists of six steps. In India, as per the legal frameworks, only the doctors are empowered to break the bad news. The first stage is setting up the stage for interview. It includes the preparation of a calm, private environment. The health care personnel who is designated to break the news is also expected to be calm and composed. The second step is perception assessment. It can be done through asking open-ended questions about what the family know about the patient's condition. The third step is obtaining patients'/relatives' invitation to talk about the issues. After ascertaining that they are ready, the fourth step is knowledge and information sharing about the patient. Brief and clear information will be helpful to solve the purpose. The fifth step is emotional support and empathetic communication. After pronouncing the death or bad prognosis of the patient, the family members may break down. They may be in disbelief or be hostile or grief struck. Give them time to allow them to express their feelings

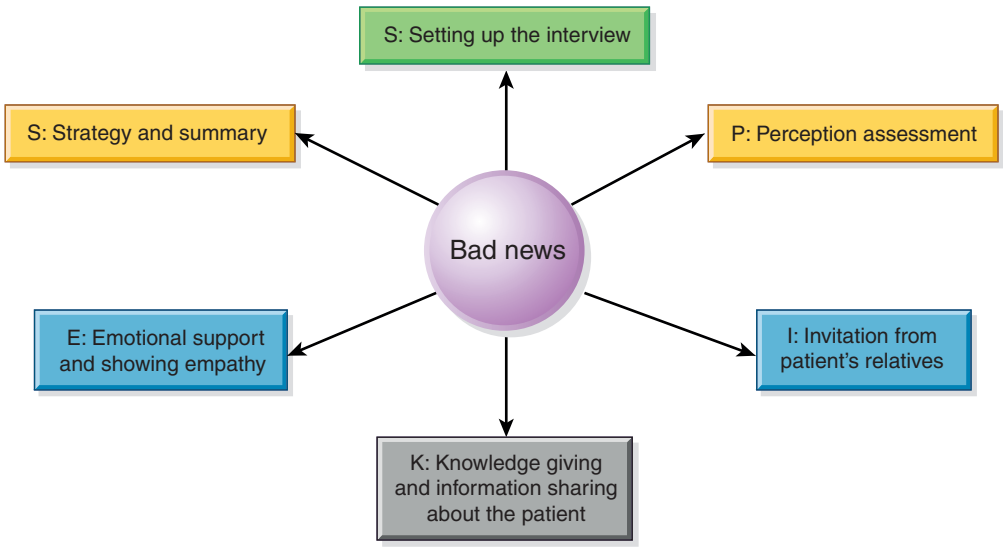


Figure 63-8 • SPIKES model of breaking bad news.

empathetically. The last step is strategy and summary. The relatives may have a lot of questions. Clarify all their doubts and support the family members and summarize the meeting proceedings. Throughout the interview, the nonverbal cues and verbal cues of the health team member need to be reassuring and supportive to the family members so as to enable them to accept and adopt the crisis situation. Figure 63-8 depicts the SPIKES model of breaking bad news.

Ethical and Legal Issues in Critical Care Nursing

Critical care unit is the most expensive unit in the hospital budget and availability of critical cervices is uneven. In many countries, the availability of critical care bed number is <1 per 1,000 beds (Datta, Chaturvedi, Rudra, et al., 2013). Technological advancement available in ICU symbolizes promise and hope from death, but, at the same time, it is viewed as an arena that imposes endless suffering for the human being. Technological advancement helps clinicians to deal with challenging situations effectively but along with that brings a lot of ethical and legal issues. Nurses, being the most inevitable member of the critical care team, play an important role in resolving ethical dilemma. They need to play their role prudently to avoid the legal hinges.

Fundamental Ethical Principles

- **Beneficence:** Nurses have an obligation to render the most appropriate interventions that will facilitate recovery for the patient
- **Nonmaleficence:** Refraining from anything that may injure or cause harm/unfavorable situations for the patients
- **Autonomy:** Respecting the patient's right to determine the course of treatment and care at ICU
- **Justice:** Fair allocation of scarce resources

Nurses who follow the Good Samaritan law, that is, doing everything for the good of the people whom they serve, still may encounter a lot of challenging situations and dilemma. Certain conditions such as persistent vegetative states and brain death where the hope for survival is almost nil, do not resuscitate (DNR) order, euthanasia, or withdrawal of life-sustaining interventions are examples of such ethically and legally challenging situations. As per the principle of autonomy, the patient's right to refuse treatment is supposed to be respected, but from the beneficence point of view, nurses have to carry out the possible interventions to prolong the life. The nurse caring in this situation may feel the dilemma. Fair allocation of resources when the ICU beds are limited also may present as an ethical dilemma.

Common Ethical and Legal Challenges

- **DNR order:** Allowing the person to die without initiating active resuscitation presents a lot of stress and dilemma to critical care team members. In the United States, 85% of deaths happen without initiating resuscitation and nearly 90% of patients had withdrawal of life-sustaining interventions, whereas in India, 78% of patients had full resuscitation instituted and only 1.6% had no active resuscitation (Datta et al., 2013). If the patient has expressed in a written document his or her healthcare choice in the event of a critical illness, which is called advance directive, or verbally passed on a message to his or her surrogate, then the DNR is accepted. In the Indian context, it is still not a legally valid practice.
- **Withdrawal of life support:** It is the cessation and removal of an ongoing medical therapy such as withdrawal of dialysis for a patient with renal failure or ventilator support to a patient with acute respiratory failure with an intent of allowing the patient to embrace natural death due to underlying illness.
- **Euthanasia:** It is an intentional killing of a person whose life is perceived to be not worth living by an act of commission or omission, that is, an intentional killing of a patient by the direct intervention of a doctor, ostensibly for the good of the patient or others (Mani, Amin, Chawla, et al., 2012). The active euthanasia is an act of commission when termination of life is done at the patient's request. It is otherwise known as physician-assisted suicide. In most of the Western countries, it is legally permitted based on the advance directive or living will or a consensus decision taken by the patient's surrogate empowered to take healthcare decisions on behalf of the patient and the treating team.

Nurses' Role in Resolving Ethical Dilemma

- As a team member, critical care nurses are not solely responsible for the end-of-life decisions in ICU. The critical care nurse may take initiative for the clear communication of the possible course of illness, the prognosis, etc., with the family members.
- He or she arranges for a consultation with the treating physician who is legally empowered to divulge the information such as the poor prognosis of the underlying condition.
- Nurse assists families to weigh the burdens and benefits of medical interventions and provides them with a framework of the patient's preferences and interests.
- Nurses provide comfort care and symptomatic relief to those patients whose surrogates or the patient himself or herself makes decision for the withdrawal of life support.
- They arrange for psychologist consultation to cope up with a situation.
- They provide moral and empathetic emotional support to the family members.

Commonly Encountered Legal Issues

- **Negligence:** It is an unintentional act of commission or omission of a nurse that is falling short of the expected standard that has resulted in injury or fatal outcome in the patient. It can be a medication error, failure to recognize a serious complication, failure to intervene promptly to avoid complications, failure to communicate a salient assessment finding or critical lab parameter to the treating physician, failure to initiate fall prevention measure that has resulted in patient falling, or loss of vision due to lack of eye care in unconscious patients.
- **Malpractice or felony:** A serious intentional act of crime is considered as malpractice such as knowingly administering a harmful drug.
- **Deformation:** Revealing highly sensitive personal information such as details of diagnosis and clinical condition without the concurrence of the patient to others that may be claimed to damage the public image or reputation of the individual. Discussing in public or with people other than the patient or his or her health surrogate is ethically an unacceptable act.

Legal Issues: Indian Perspective

The common law binding the nurses in ICU is the Consumer Protection Act (1986). The Consumer Protection Act was passed in the Parliament of India and made a law to protect the best interests of the patient who as per this law is considered as the consumer of health. The practice of nursing is also brought under the ambit of this law. Earlier, only the hospitals and treating physicians were legally accountable for what happened to a patient and nurses were having only vicarious liability. Now, nurses also are responsible for any errors committed by them. Nurses face crime charges when they fall short of the standards of care. Few examples are given as follows: (Hemant Kumar, Gokhale, Jain, 2013):

- Medication error caused by a nurse at Spring Meadows Hospital in 1993 resulted in permanent brain damage and the nurse was punished for her below-standard care.
- Nurse was held responsible for the administration of a mismatched blood transfusion that caused death in KC General Hospital, Bengaluru.

Other laws governing nursing practice are Human Organ Transplant Act, 1994, and Right to Information (RTI) Act, 2005.

In *Aruna Shanbaug vs Union Government of India*, a case was filed in the Supreme Court on March 7, 2011, for granting an order for euthanasia of a lady who was in persistent vegetative state for 37 years. In this landmark case, certain progresses have been made. The court of law shall consider the passive euthanasia or withdrawing life support based on the plea of the legal surrogate of the patient and the expert committee's report consisting of a neurologist, a psychiatrist, and a physician. Before this case, withdrawing life support was considered as a crime on the part of the treating doctors and hospital authorities.

Responsibilities of Nurse in Avoiding Legal Issues

- Critical care nurses need to continuously update their knowledge and competency to match the rapidly expanding medical knowledge base. Lack of updating may lead to medication errors and failure to monitor and implement nursing care.
- Accurately monitoring and documenting the parameters as well as the care provided will save the nusres from litigation.
- Informing all relevant people about the patient's condition not only paves way for quality care but also provides legal protection.
- Maintain the prescribed standards of care to the patients.
- Develop trusting and healthy relationship at the workplace.
- System approach to prevent errors has been effective and enhances accountability and direction for each member of the healthcare team in the ICU.

Nurses' Role in Identification and Management of Inpatient Arrest

Tackling cardiac arrest event through prompt identification and effective resuscitation is part of day-to-day affair in the critical care units as well as in ER. The code blue teams are organized with competent trained health manpower for successful resuscitation. Once the cardiac arrest is identified, code blue team is called for to salvage the patient through public call system.

Cardiac Arrest

In cardiac arrest, the heart is unable to pump and circulate blood to the body's organs and tissues. It is often caused by a dysrhythmia such as ventricular fibrillation, progressive bradycardia, or asystole (i.e., absence of cardiac electrical activity and heart muscle contraction). Cardiac arrest can also occur when electrical activity is present on the ECG but cardiac contractions are ineffective, a condition called **pulseless electrical activity (PEA)**. PEA may be caused by a variety of problems such as profound hypovolemia (e.g., hemorrhage). Diagnoses that are associated with cardiac arrest include MI, massive pulmonary emboli, hyperkalemia, hypothermia, severe hypoxia, and medication overdose. Rapid identification of these problems and prompt intervention can restore circulation in some patients. Although survival after cardiac arrests that occur in the hospital is reported to be approximately 22%, survival is more likely when current AHA guidelines are followed (Anderson, Nichol, Dai, et al., 2016).

Clinical Manifestations

In cardiac arrest, consciousness, pulse, and blood pressure are lost immediately. Breathing usually ceases, but ineffective respiratory gasping may occur. The pupils of the eyes begin dilating in less than a minute, and seizures may occur. Pallor and

cyanosis are seen in the skin and mucous membranes. The risk of organ damage, including irreversible brain damage, and of death increases with every minute that passes. A patient's age and overall health determine his or her vulnerability to irreversible damage. As soon as possible, the diagnosis of cardiac arrest must be made and action taken immediately to restore circulation.

See Chapter 23 for the detailed steps of basic cardiac life support.

Advanced Cardiovascular Life Support

Additional care may be indicated for patients in cardiac arrest when the spontaneous circulation and breathing are not evident and the team of providers trained in advanced cardiac life support (ACLS) has arrived on the spot. Components of ACLS include placement of an advanced airway, continuous cardiac monitoring, defibrillation and administration of IV drugs along with high-quality CPR. An ACLS team consists of trained and certified ACLS providers who may be a physician, nurse anesthetist, or respiratory therapist; nurses are empowered to perform ACLS. One among the team assumes the role of the leader who will be responsible for quick assessment and clinical decision making. The cardiac rhythm analysis and defibrillation are vital skills needed for the team leader. The roles of other members are assigned by the team leader. A team member who is competent in the insertion of advanced airway such as an ET tube may be assigned to airway management and for artificial respiration and the other one will be assigned to perform cardiac compression. The next member may be assigned to defibrillate as and when ordered by the team leader. The other team member may insert an IV line and administer the emergency drugs such as adrenaline, adenosine, or lignocaine. Depending on the assessment of the patient's condition, the ACLS team uses various algorithms that are treated as pathways to be followed. If an asystole is detected on the monitor, first ensure that the leads are attached to the chest adequately with enough gel. As per the asystole algorithm, CPR is continued. Epinephrine is given while attempts are made to resolve the basic causes such as severe hypovolemia or hypoxia. Additional information on ACLS may be obtained from the website of the American Heart Association – ACLS algorithms (https://acls-algorithms.com/acls-algorithm-overview/). For details of medications used in ACLS, see Table 63-4.

TABLE 63-4 Drugs Used in Critical Care

Name of the Drug	Mechanism of Action	Indication	Side Effects	Nursing Implications
Adenosine	Slows down the cardiac impulse conduction in AV node, interrupts reentry pathway	Supraventricular tachycardia	Light-headedness, numbness, chest pain, sweating, palpitation, hypotension, nausea, vomiting, increased respiratory rate	Monitor vitals and ECG. Discontinue the drug if there is increase in pulse, respiration
Atropine	Anticholinergic, parasympatholytic, antiarrhythmic	In bradyarrhythmia, organophosphorus poisoning, premedication in surgical patients	Headache, dizziness, confusion, tachycardia, insomnia, dryness of mouth, GI spasm, blurred vision, urinary retention, PVC	I/O chart, ECG monitoring for PVCs, watching for constipation, urinary retention
Aminophylline	Relaxes bronchial smooth muscle, bronchodilation	Bronchial asthma, chronic bronchitis, emphysema	Seizure, tachyarrhythmia, nausea, vomiting	No IM, only slow IV infusion. Monitor I/O chart. If urticaria develops, discontinue the drug
Amiodarone	Antiarrhythmic agent prolongs PR and QT interval, decreases sinus rate and peripheral vascular resistance	Ventricular tachycardia, AF, SVT	Confusion, numbness, headache, dizziness, blurred vision, photophobia	Monitor ECG and electrolyte levels. If confusion, psychosis, and numbness develop, stop the drug
Dopamine	Inotropic agent, increases myocardial contractility, and thereby increases cardiac output. Activates the α and β_1 receptors, and also dopaminergic receptors present in the renal and mesenteric blood vessels. It produces varied dose-related responses At a dose of <3 μg, it produces renal response to increase urine output, and at 3 to 10 μg, it increases cardiac output and BP. Dose more than 10 μg produces vasoconstriction	Shock, hypotension	Palpitation, tachycardia, ectopic beats; wide QRS with extravasation causes tissue necrosis	Monitor vitals, continuous BP monitoring, and ECG monitoring. If BP increases, start tapering the dose. I/O chart Ensure fluid volume adequacy with CVP values before dopamine infusion. Administer in central vein using infusion pump

(*Continued*)

(*Continued*)

Dobutamine	Increases myocardial contractility and cardiac output, β agonist	Heart failure, cardiac surgery	Heartburn, nausea, palpitation, tachycardia, hypertension	Ensure fluid volume adequacy with CVP values and cardiac glycoside before dobutamine infusion. Use central line or a large-bore peripheral IV line using syringe pump. Monitor BP, pulse, ECG, serum electrolytes continuously. With increase in BP, the dose has to be tapered
Furosemide	Potent loop diuretic, enhances excretion of sodium and water	Heart failure, to decrease ICP, to reduce fluid overload in renal failure, hepatic failure	Hypokalemia	K^+ ions are also excreted. Be alert for signs of hypokalemia Monitor urine output
Isoprenaline	A synthetic sympathomimetic amine that is structurally related to epinephrine but acts almost exclusively on beta receptors	Bradycardia, AV nodal block, or refractory torsade de pointes	Angina, flushing, hypertension/ hypotension, pallor, palpitation, paradoxical bradycardia (premature ventricular beats, ventricular arrhythmia) Dizziness, headache, nervousness, restlessness	Monitor heart rate, BP, and ECG
Levetiracetam	It binds to the synaptic vesicle protein namely SV2A and thereby delays the neural conduction across the syapses	Seizure disorder	Somnolence, dizziness, fatigue	Be watchful for allergic reaction such as itching; shortness of breath; wheezing; cough; swelling of face, lips, tongue, or throat; or any other signs. The medicine should be discontinued in case of allergic reaction
Potassium chloride	Replenishes potassium ion in case of hypokalemia	To correct hypokalemia	Highly concentrated solution of K^+ ions. Should be infused slowly. Narrow safety limit can cause hyperkalemia if exceeds the normal limit	Never given as IV bolus, should be given only as infusion slowly. Needs continuous cardiac monitoring and serum K^+ monitoring
Sodium bicarbonate	Hypertonic bicarbonate solution intended to replenish bicarbonate ion in serum	Corrects metabolic acidosis of various causes, lactic acidosis, cardiac arrest	Sodium retention is possible. In patients with congestive heart failure, it should be used with caution	Extravasation can cause tissue necrosis
Lidocaine CV	Antiarrhythmic agent Combines with sodium channel and reduces myocardial excitability and conductivity	Ventricular tachycardia, ventricular fibrillation that occur after cardiac arrest or acute coronary syndrome	Nausea, vomiting	Needs continuous cardiac monitoring Can be given 1 to 1.5 mg/kg two to three times IV
Morphine	Potent narcotic analgesic	Pain relief especially in MI, postoperative analgesia	Respiratory center depression	Monitor for pain relief CNS depression Use with caution in bronchial asthma
Magnesium sulfate	Can reverse refractory VF caused by hypomagnesemia and help to replenish intracellular potassium	Treatment and prevention of hypomagnesemia Prevention and treatment of seizures in severe preeclampsia or eclampsia, pediatric acute nephritis, torsade de pointes, treatment of cardiac arrhythmias (VT/VF) caused by hypomagnesemia	Flushing, hypotension, vasodilation Hypermagnesemia Absence of knee jerk reflex, cardiac arrest, circulatory collapse, CNS depression, complete heart block	Monitor serum magnesium level Slow administration to minimize risk of complications

(*Continued*)

(*Continued*)

Nitroglycerine	Selective coronary vasodilator	Acute myocardial infarction to improve the myocardial perfusion and reduce the chest pain and reduce blood pressure	Produces venous dilatation and may cause hypotension, headache, dizziness	Produces serious drug interaction if the patient is taking sildenafil In case of AMI, it may be given as IV infusion. Monitor the BP and if systolic BP falls below 90 mmHg, it should not be given
Noradrenaline	α-Adrenergic agonist, increases vasoconstriction and thereby increases BP	Hypotension, septic shock, neurogenic shock superior to dopamine	Dizziness, weakness, feeling cold and numbness	Monitor the blood pressure; taper the dose
Vasopressin	Synthetic antidiuretic hormone that increases sodium and water reabsorption in the kidney	Hypotension, acute circulatory failure Bleeding esophageal varices, diabetes insipidus	Slow or uneven heart rate Gasping Swelling Rapid weight gain	Establish baseline data of BP, weight, I&O chart Monitor BP and weight throughout therapy Monitor urine output, specific gravity, and serum osmolality

Defibrillation

Cardiac monitor/defibrillator cables are attached to an electrical source, monitor electrodes are applied to the patient's chest, and the heart rhythm is analyzed. When an automated external defibrillator (AED) is used, the device is turned on, the pads are applied to the patient's chest, and the rhythm is analyzed by the defibrillator to determine whether a shock is indicated. When the ECG shows ventricular fibrillation or ventricular tachycardia, immediate defibrillation is the treatment of choice. The survival time decreases for every minute that defibrillation is delayed. Following defibrillation, high-quality CPR is resumed immediately. Survival after cardiac arrest has been improved by extensive education of health care providers and by the use of AEDs. Nurses need to be alert that none is in contact with the patient or the beds or railing while shock is delivered to the patient

Follow-Up Monitoring and Care

The care provided to the patient following resuscitation is another determinant of survival (Williams et al., 2013). The patient may be transferred to an ICU for close monitoring. Continuous ECG monitoring and frequent blood pressure assessments are essential until hemodynamic stability is established. Factors that precipitated the arrest such as dysrhythmias or electrolyte or metabolic imbalances are identified and treated.

Following resuscitation and return of spontaneous circulation, patients who are comatose may benefit from therapeutic hypothermia protocols. These induce a drop in core body temperature to 32°C to 34°C (89.6°F to 93.2°F) for 12 to 24 hours post resuscitation in order to decrease the cerebral metabolic rate and need for oxygen. Specific protocols have been developed to guide the use of both external cooling and catheter-based cooling methods and reduce associated complications such as shivering (Avery et al., 2015).

Advances in cardiac care, such as new techniques for effective resuscitation and postresuscitation hypothermia, have improved outcomes for patients with potentially lethal cardiac disorders, including those with cardiac arrest. Studies have demonstrated better neurological recovery and overall survival for patients after cardiac arrest, and hope for even better outcomes in the future.

CPR may be stopped when a pulse and blood pressure are detected, respirations are detected, and the patient responds. CPR efforts may also be stopped when rescuers are exhausted or at risk (e.g., a building is at risk of collapsing), or death is considered to be inevitable. If the patient does not respond to therapies given during the arrest, the resuscitation effort may be stopped by the physician or other provider in charge of the resuscitation. Many factors are considered in the decision, such as the initiating dysrhythmia, potential etiology, length of time for initiation of life support, and the patient's response to treatment.

REFERENCES

Books

The Intensive Care Society. (1997). Standards for intensive care units. London: The Intensive Care Society, pp. 1–72.

Swaminathan, S. Hospital infection control guidelines. New Delhi: Indian Council of Medical Research, pp. 1–103.

Journals and Electronic Documents

Anderson, M. L., Nichol, G., Dai, D., et al. (2016). Association between hospital process composite performance and patient outcomes after in-hospital cardiac arrest care. JAMA Cardiology, 1, 37–45.

Apker, J., Propp, K. M., Ford, W. S. Z., & Hofmeister, N. (2006). Collaboration, credibility, compassion and coordination professional nurse communication skill sets in health care team interactions. Journal of Professional Nurse, 22(3), 180–189.

Arif, M., Joseph, D., Grap, M. J., & Ferguson, P. (2014). Validity and sensitivity of 6 pain scales in critically ill, communicative and non communicative intubated adults. American Journal of Critical Care, 23(3), e38.

Arora, M. K. (2012). Minimum standards for ICUs (intensive care units) to be adopted throughout the country. The draft prepared by the committee co-ordination cell/Estt. 1–7. Retrieved on 07/25/2018 at http://www.hp.gov.in/dhsrhp/ICU.pdf

Avery, K. R., O'Brien, M., Pierce, C. D., et al. (2015). Use of a nursing checklist to facilitate implementation of therapeutic hypothermia after cardiac arrest. Critical Care Nurse, 35(1), 29–38.

Baile, W. F., Buckman, R., Lenzi, R., et al. (2000). SPIKES—a six-step protocol for delivering bad news: Application to the patient with cancer. The Oncologist, 5(4), 302–311.

Barr, J., Fraser, G. L., Puntillo, K. P., et al. (2013). Clinical practice guidelines for the management of pain, agitation and delirium in adult patients in the intensive care unit. Critical Care Medicine, 41, 263–306.

Boltey, E., Yakusheva, O., & Costa, D. K. (2017). Nursing strategies to prevent ventilator-associated pneumonia. American Nurse Today, 12(6), 42–43.

Chang, S. Y., Sevransky, J., & Martin, G. S. (2012). Protocols in the management of critical illness. Critical Care. 16p, 306.

Collini, A., Parker, H., & Oliver, A. (2021). Training for difficult conversation and breaking bad news over phone in the ED. Emergency Medical Journal, 38(2). Retrieved on 6/20/2022 at: https://emj.bmj.com/content/38/2/151.

Datta, R., Chaturvedi, A. R., Rudra, A., & Jaideep, N. (2013). End of life issues in intensive care unit. Medical Journal Armed Forces India, 69, 48–53.

Franklin, C., & Mathew, J. (1994). Developing strategies to prevent in-hospital cardiac arrest: Analysing responses of physicians and nurses in the hours before the event. Critical Care Medicine, 22, 244–247.

Frost, P., & Wise, M. P. (2007). Recognition and early management of critically ill ward patient. British Journal of Hospital Medicine, 68(10), M180–M183.

Gould, C. V., Umscheid, C. A., Agarwal, R. K., Kuntz, G., & Pegues, D. A. (2017). The Healthcare Infection Control Practices Advisory Committee (HICPAC). Guideline for prevention of catheter-associated urinary tract infections 2009. Retrieved on 10/19/2017 at: http://www.cdc.gov/infection control/guidelines/cauti.

Gunasekera, P. & Gatrix, A. (2016). Ventilator-associated pneumonia. British Journal of Anaesthesia Education, 16(6): 198–202.

Haddadin, Y. & Regunath, H. (2017). Central line associated blood stream infections (CLABSI) (updated March 28, 2017). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing.

Happ, M. B., Tuite, P., Dobbin, K., Thomas, D. D. V., & Kitutu, J. (2004). Communication ability, method and content among non-speaking non-surviving patients treated with mechanical ventilation in the intensive care unit. American Journal of Critical Care, 13(3), 210–220.

Hemant Kumar, Gokhale, Jain, K., & Mathur, D. R. (2013). Legal awareness and responsibilities of nursing staff in administration of patient care in a trust hospital. Journal of Clinical and Diagnostic Research, 7(12), 2814–2817.

Hervé, M., Zucatti, P. B., & Lima, M. (2020). Transition of care at discharge from the intensive care unit: a scoping review. Revista Latino-Americana de Enfermagem, 28, e3325.

Hobbs, J. L. (2009). A dimensional analysis of patient-centred care. Nursing Research, 58(1), 52–69.

Joszt, L. (2020). Communicating bad news effectively and compassionately. Retrieved on 6/20/2022 at: https://www.ajmc.com/view/communicating-bad-news-effectively-and-compassionately-in-the-icu.

Labeau, S. O., Blot, S. I., Rello, J., & Vandijck, D. M. (2010). Infection control in the ICU: The nurse perspective. ICU Management & Practice, ICU, 9(4).

Mani, R. K., Amin, P., Chawla, R., et al. (2012). Guidelines for end-of-life and palliative care in Indian intensive care units. ISCC consensus ethical positions statement. Indian Journal of Critical Care Medicine, 16(3), 166–181.

Manimala, S. R. & Subashini, T. (2003). Organization of intensive care unit and predicting outcome of critical illness. Indian Journal of Anesthesia, 47(5), 328–337.

Marschall, J., Mermel, L., Fakih, M., et al. (2014). Strategies to prevent central line associated blood stream infections in acute care hospitals: 2014 update. Infection Control & Hospital Epidemiology, 35(7), 753–771.

Marshall, J. C., Bosco, L, Adhikari, N. K., et al. (2017). What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. Journal of Critical Care, 37, 270–276.

McAdam, J. L. & Puntillo, K. (2009). Symptoms experienced by family members of patients in intensive care units. American Journal of Critical Care, 18(3), 200–209.

McClave, S., Taylor, B. E., Martindale, R. G., et al. (2016). Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine and American Society for Parental and Internal Nutrition. Journal of Parental and Enteral Nutrition, 40(2), 159–211.

Meaney, P. A., Bobrow, B. J., Mancini, M. E., et al. (2013). Cardiopulmonary resuscitation quality: Improving cardiac resuscitation outcomes both inside and outside the hospital. A consensus statement from the American Heart Association. Circulation, 128(4), 417–435.

Mehta, Y., Gupta, A., Todi, S., Myatra, S. N., Samaddar, D. P., & Patil, V. (2014). Guidelines for prevention of hospital acquired infections. Indian Journal of Critical Care Medicine, 18(3), 149–163.

Milic, M. M., Puntillo, K., Turner, K., Joseph, D., Peters, N., & Ryan, R. (2015). Communication with patient's families and physicians about prognosis and goals of care. American Journal of Critical Care, 24(4), e56–e64.

Morris, L. L., Bedon, A. M., McIntosh, E., & Whitmer, A. (2015). Restoring speech to tracheostomy patients: Critical Care Nurse, 35(6), 13–27.

Neumar, R. W., Shuster, M., Callaway, C. W, et al. (2015). Part I, executive summary: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation, 132(18), S315–S367.

Payen, J. F., Bru, O., Bosson, J. L., et al. (2001). Assessing pain in critically ill sedated patients by using a behavioral pain scale. Critical Care Medicine, 29(12), 2258.

Preiser, J. C., Van Zanten, A. R. H., Berger, M. M., et al. (2015). Metabolic and nutritional support of critically ill patients: Consensus and controversies. Critical Care, 19(35), 1–11. Retrieved on 07/24/2018 at https://ccforum.biomedcentral.com/articles/10.1186/s13054-015-0737-8

Ranjan, N., Chaudhary, U., Chaudhry, D., & Ranjan, K. P. (2014). Ventilator-associated pneumonia in a tertiary care intensive care unit: Analysis of incidence, risk factors and mortality. Indian Journal of Critical Care Medicine, 18(4), 200–204.

Ray, B., Samaddar, D. P., Todi, S. K., Ramakrishnan, N., John, G., & Ramasubban, S. (2009). Quality indicators for ICU: ISCCM guidelines for ICUs in India. Indian Journal of Critical Care Medicine, 13(4), 173–206.

Rodriguez, C. S., Rowe, M., Thomas, L., Shuster, J., Koeppel, B., & Cairns, P. (2016). Enhancing the communication of suddenly speechless critical care patients. American Journal of Critical Care, 25(3), 40–47.

Rose, L., Smith, O., Gelinas, C., Haslam, L., Dale, C., & Luk, E. (2012). Critical care nurses' pain assessment management practices: A survey in Canada. American Journal of Critical Care, 21(4): 251–259.

Rungta, N., Govil, D., Nainan, S., Munjal, M., Divatia, J., & Jani, C. K. (2010). ICU planning and designing in India—ISCCM guidelines. Retrieved on 01/7/2018 at: http://www.isccm.org/pdf/Section1.pdf.

Schnock, O. K., Ravindran, S. S., Fladger, A., et al. (2017). Identifying information resources for patients in the intensive care unit and their families. Critical Care Nurse, 37(6), e10–e16. Retrieved on 8/1/2018 at http://ccn.aacnjournals.org/content/37/6/e10.abstract.

Slatore, C. G., Hansen, L, Ganzini, L., et al. (2012). Communication by nurses in the intensive care unit: Qualitative analysis of domains of patient-centered care: American Journal of Critical Care, 1(6), 410–418.

Subbe, C. P., Kruger, M., Rutherford, P., & Gemmel, L. (2001). Validation of a modified early warning score of medical admissions. Quarterly Journal of Medicine, 94, 521–526.

Williams, D., Calder, S., Cocchi, M. N., et al. (2013). From door to recovery: A collaborative approach to the development of a post-cardiac arrest center. Critical Care Nurse, 33(5), 42–55.

Wilson, T., Haut, C., & Akintade, B. (2017). Improving health care provider communication in end-of-life decision-making. Advanced Critical Care, 28(2), 124–132.

World Health Organization. (2016). Transitions of care. Retrieved on 21/7/2022 at: https://apps.who.int/iris/bitstream/handle/10665/252272/9789241511599-eng.pdf.

Xu, M., Tam, B., Thabane, L., & Robichaud, A. F. (2015). A protocol for developing early warning score models from vital signs data in hospitals using ensembles of decision trees. BMJ Open, 5(9), e008699, doi: 10.1136/bmjopen-2015-008699.

UNIT

XXII

Occupational and Industrial Care

Chapter 64 Management of Patients with Occupational and Industrial Disorders . . . 2087

CHAPTER 64

Management of Patients with Occupational and Industrial Disorders

LEARNING OBJECTIVES

On completion of this chapter, the learner will be able to:

1. Define the occupational health and occupational disease.
2. Discuss the importance of health work environment to maintain occupational health.
3. Describe the occupational risk factors causing occupational disease.
4. Explain the nature of various occupational diseases.
5. Identify the measures to prevent and control the occupational diseases among healthcare workers.
6. Explain the global and national strategies for prevention and control of occupational diseases.
7. Elaborate the nurses' role in prevention of occupational and industrial disorders.

GLOSSARY

body mechanics: efficient and coordinated use of body parts while we engage in activities of daily living, preventing undue wear and tear of various joints, muscles, and body parts

ergonomics: the science of refining the design of products to optimize them for human use or rearranging the work environment for efficient use of workplace and machinery for the workers

occupational dermatitis: a form of skin disease for which exposure to any agent present in the work or chemicals could be established as a cause

occupational diseases: any disease contracted primarily as a result of exposure to risk factors arising from work or the work environment

occupational health: as a multidisciplinary activity aimed at protection and promotion of health of workers by preventing and controlling occupational diseases and accidents by eliminating the occupational factors and conditions hazardous to health and safety at work

occupational hygiene: the science of monitoring the work environment for the measurement of occupational hazards and advocating appropriate modification in designing and processing in the industries to make workplace safer

occupational risk factor: any physical, chemical, biological, or other agent that may cause harm to an exposed person in the workplace and is potentially modifiable

occupational safety: preventive measures taken to identify and eliminate the harmful effects of the hazards present in the work processes or work environment

pneumoconiosis: an umbrella term given to a type of occupational lung disease caused by dusts that are breathed in and get deposited deep in the lungs causing damage; usually includes asbestosis, silicosis, and coal workers' pneumoconiosis (CWP), or "black lung disease"

postexposure prophylaxis (PEP): preventive measures taken after accidental exposure of nonintact skin and mucous membrane to body fluids potentially harboring blood-borne pathogens such as HBV, HCV, and HIV

Introduction

Health and well-being of the people living in the country decide the development index of that country. The health of working population plays a vital role in bringing prosperity and development of the nation. Their contribution is directly responsible for improving the economy and the gross domestic product (GDP) of the country. In a developing country like India, health of the working member is much more important to feed the family members and sustain the family. Workers constitute one-third of the world population and are the major contributors of growth and development (Ivanov, 2013).

While the workers are engaged in their work, they get exposed to factors that affect their health and well-being, which leads to absenteeism and loss of workforce, ultimately affecting the productivity. Hence, the World Health Organization (WHO) and the governments of various countries have initiated measures to mitigate the negative effect of work milieu and nature of work on health of the employees. The Government of India also considers it as a basic human right and also integrated occupational health in the National Health Policy 2002.

Historical Perspectives of Global Occupational Health Initiatives

The WHO and the International Labour Organization (ILO) are the two nodal agencies at the global platform responsible for upholding the health and well-being of the working population. In 1950, the Joint Committee of ILO and WHO for occupational health was formed. From then onwards to till date, the efforts of this Joint Committees focus on various issues surrounding workers' health across nations. The ILO conventions held in 1981 and 1985 urged the member countries to draft their national occupational health policies to prevent accidents and injury by minimizing the hazards at workplace. These conventions called for expansion of occupational health services to both public and private sector enterprises. Under occupational health services, emphasis was given to include occupational surveillance of the work environment for harmful elements as well as the workers' health surveillance, provision of occupational hygiene measures, ergonomics at workplace, first aid, and rehabilitation services.

Global declaration of occupational health for all was made in Beijing in 1994 by the WHO (WHO, 1994). It urged member

states to improve occupational health services including accident prevention and psychosocial stress. In 1996, global strategy for occupational health for all was agreed upon by the member countries. Ten priority areas were identified to be strengthened under the ambit of occupational health services. The third priority focused on the lifestyle factors and health promotion at workplace. In 2006 and 2007, global plan of action on workers' health was agreed upon by the WHO collaborating centers atItaly. It urged the need for holistic approach in improving the occupational health and safety by integrating the preventive approach and promotion, along with addressing the social inequalities. Priority areas for action were elucidated with specification of objectives for member nations. The ILO convention held in 2006 also emphasized the need to strengthen the occupational health services in their respective countries.

Occupational Health

Definition

It deals with the promotion of health and prevention and control of work-related injuries and diseases to individuals at their work. The WHO (2001) has defined occupational health as a multidisciplinary activity aimed at protection and promotion of health of workers by preventing and controlling occupational diseases and accidents by eliminating the occupational factors and conditions hazardous to health and safety at work. It also aims at promoting physical, mental, and social well-being of the workers so as to enhance their social and professional work capacity (WHO, 2001).

Occupational health will pave way for the development of individual workers and the enterprises in which they work, thereby contributing to the sustainable development of the community and country.

Stakeholders of Occupational Health

National Governments

As signatories of the WHO 1996 Declaration of Global Strategy for Occupational Health for All, the governments of the countries have a responsibility to ensure implementation of measures to promote occupational health. The legislative measures and occupational health policy should provide for tight control over the use of hazardous material in the work process, and financial sanction for provision of occupational health. Threat to environment and the community also should be tackled by the Ministry of Health. The government initiatives should also focus on the maintenance of green environment and safe processes.

Management of Industries and Enterprises

The management of the factories, whether public or private, needs to take measures to ensure safety at work environment and also to prevent ill effects of occupational exposure to hazardous substances. They have to contribute to promote positive physical, mental, and social well-being of the workers.

Workers/Employees

The employees have to be aware of the possible ill effects of work-related processes and the environment. They have to follow safety norms and create a safe work culture. The workers' role in achieving occupational health cannot be compromised.

Trade Unions

Trade unions should be vigilant to ensure that the necessary occupational health and safety measures are implemented and in case of lapse in safety issues and health measures, they can negotiate with the representatives of the management.

Community

Community members also play a vital role in ensuring safe work environment. A community residing around the factory or industry is invariably affected by the processes and products used in the industry. Hence, maintaining the health of the community depends on the safety at the factories. During the Bhopal gas tragedy in 1984, a lot of people who resided around the Union Carbide factory died. Occupational health promotion indirectly promotes the community health promotion.

Occupational Health Team

The occupational team consists of the following:

- Consultant specialized in occupational medicine
- Occupational or industrial nurse
- Industrial hygienist
- Environmental and safety engineer
- Ergonomist
- Physiotherapist
- Counselor

The members of the team have their unique specified roles to play to ensure occupational health of the working population. The team members work together to prevent occupational diseases, promote health, and rehabilitate in case of any occupational health problems of the workers.

Healthy Workplace

To ensure occupational health, healthy work environment is the prerequisite. Healthy workplace is schematically represented in Figure 64-1. According to the WHO, characteristics of healthy workplace are the following:

- The healthy workplace should be free of physical, chemical, and biological hazards.
- It should be a place where workers and managers collaborate toward mutually acceptable roles, free from conflicts and occupational stress. The work environment should be psychologically and socially favorable so as to make everyone feel energized, positive, and satisfied.

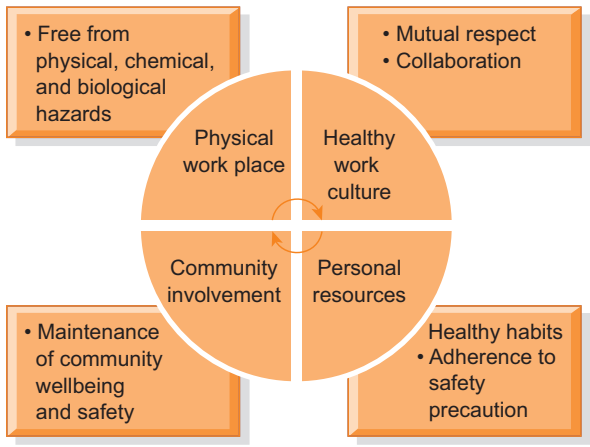


Figure 64-1 • Characteristics of a healthy workplace. Adapted from the WHO model of healthy workplace, 2010.

- The workplace should facilitate healthy lifestyles and enhance personal resources among workers and managers to maintain health and adherence to safety precaution. It may have restrictions for smoking, alcohol, etc.
- A factory or workplace is always surrounded by people. Workplace safety ensures welfare of not only the workers but also the general public residing in that particular community. Involving the community ensures safety for both the workers and the community. There can be health clubs or physical fitness studios in the community. Tree plantation and other measures to ensure safe environment for the community residing closer to the factory are some initiatives to involve community (Burton, 2010).

Occupational Disease

An "occupational disease" is any disease contracted primarily as a result of an exposure to risk factors arising from work activity or the work environment. "Work-related diseases" have multiple causes, where factors in the work environment may play a role, together with other risk factors, in the development of such diseases. Occupational diseases are related to the dose and frequency of exposure to the particular causative factor. Occupational factors in conjunction with nonoccupational or lifestyle factors may increase the chance of occupational disease or worsen the clinical scenario. For example, inhalation of hazardous mineral particles leads to a serious effect when combined with cigarette smoking as the filtration functions of mucociliary apparatus are negated in smokers. So compared with nonsmokers, smokers are more prone to occupational lung mesothelioma (WHO, 2001).

In some conditions, the onset of pathological change may go unnoticed due to long latency period and the patient may be asymptomatic, and in some instances, even after termination of exposure to the hazardous occupational factors, the disease may occur, for example, asbestosis (Cullinn, P., Munoz, X., Agius, et al., 2017).

Most of the time, the occupational diseases are overlooked because the clinical presentation may be very similar to that of general diseases with nonoccupational exposure. For example, bronchial asthma due to certain chemical exposure is no different from other causes.

Occupational diseases are always dose related. Intensity and duration of exposure to hazardous elements in the work processes or work environment decide the nature and severity of illness. For example, occupational hearing loss occurs after many years of exposure to loud noise.

Magnitude of the Problem

Global estimates of occupational diseases and occupational accidents result in over 2.3 million fatalities annually. Approximately 6,300 people die every day because of occupational disease or accident (Nenonen & Saarela, 2014). There are 100 million occupational injuries causing 0.1 million deaths in the world according to the WHO. It is also estimated that in India, 17 million occupational nonfatal injuries (17% of the world) and 45,000 fatal injuries (45% of the total deaths due to occupational injuries in the world) occur each year. Out of 11 million cases of occupational diseases in the world, 1.9 million cases (17%) are contributed by India, and out of 0.7 million deaths in the world, 0.12 million deaths (17%) are contributed by India (National Programme for Control & Treatment of Occupational Diseases, 2014).

Occupational Health Hazards

- *Physical factors*: Heat, light, noise, and radiation
- *Chemical factors*: Industrial dusts, heavy metals such as lead, zinc, iron, benzene, toluene, gases, acids, alkali, and pesticides
- *Biological factors*: Inhalation of live organisms or spores
- *Behavioral factors*: Ergonomics-related factors

Physical Agents Causing Occupational Disease

Extremes of Heat and Cold

- Extreme heat causes vasodilation and later leads to heat stroke and unconsciousness. Traffic policemen patrolling under the hot sun and workers working in high-temperature furnaces become victims of heat stroke. People with concomitant renal or cardiac ailments and elderly are more prone to heat stroke. Welders, foundry workers, and workers in glass factories and steel rolling mills are exposed to extremes of heat. Gradual acclimatization can reduce the acute effect of high temperature.
- Extreme coldness can cause frostbite or death due to vital organ dysfunction. Army men working in Siachen Glacier in Himalayas often lose their foot or life because of extreme hypothermia.

Noise and Vibration

- Continuous exposure to loud noise can result in hearing loss. Our ears cannot withstand sound waves of more than 85 dB intensity. When an individual is exposed to sounds of high intensity for 5–7 years, noise exposure can lead to permanent hearing loss (National Institute of Deafness and Other Communication Disorder, 2017).
- Vibrations associated with jerky movements such as those while drilling and mining can lead to disturbances in hand and wrist functioning and pain.

Radiation

- UV radiation, infrared radiation, and ionizing radiation can cause ill effects.
- Exposure to infrared radiation occurs in men and women working near furnaces in steel mills and glass factories.
- Ionizing radiation arises from atomic power plants. X-rays and radiation therapy units used in medical field also emit ionizing radiation. Health hazards depend on the intensity, exposed area, and length of exposure. A sudden explosion as that happened in the atomic power plant Chernobyl in the USSR in 1986 can lead to death. The small amount of chronic exposure can lead to infertility, skin changes, alopecia, etc.

Light

- Exposure to intense light with UV rays as the light emanating in the process of welding can cause damage to the cornea of the eye, leading to welder's arc. Prolonged exposure for more than 3 hours can cause damage to the cornea (Dahl & Stoppler, 2017).
- Mild to severe pain in the eyes, excessive tearing, redness, and blurring of vision can result from the burns in the cornea. In this condition, bilateral corneal injury occurs.

Ergonomics

- Poor ergonomics can lead to injury.
- Repetitive movements such as those of people involved in data entry operations, blacksmiths, and goldsmiths use the small muscles of the hands, which leads to an inflammation

of the tendon sheath of hands and wrist and leads to carpel tunnel syndrome.
- Lifting excessive weight can lead to injury.
- Eye strain can occur in some occupations.
- High levels of vibration as seen in assembly line movement can cause vibration.

Primary Prevention of Physical Hazards

Noise Control

- Engineering and design changes can be done for noise reduction.
- Shielding can be done around noisy equipment.
- Machines should be kept in a good working condition.
- Silencers should be installed wherever possible.
- Acoustic principles should be applied to contain noise.
- Walls should be soundproof to contain high-intensity noise.
- Exposure to noise should be limited.

Extremes of Heat Control Measures

- To prevent extremes of heat, appropriate clothing can be worn.
- Air conditioning should be installed in the workplace and ventilation should be increased.
- There should be adequate hydration of the workers.
- Shelters and places to rest in between the long working hours should be provided in extremes of temperature.
- To tackle radiation hazard, containment or shielding can be done.
- Employees should be educated about the warning signs of heat stroke and preventive measures.

Radiation/Light Hazard Prevention

- Minimize the number of workers in areas with known risk of radiation.
- The distance between the source and workers should be increased.
- Length and quantum of exposure to radiation should be reduced.
- Shielding the ionizing radiation source will protect people from getting unnecessary exposure.
- Provision of personal protective equipment such as lead jackets and gloves can effectively shield an individual from radiation.
- Welders can be provided with protective goggles while working.

Secondary Prevention

- Early detection of hearing loss and corrective measures
- Identification of heat-induced electrolyte loss and supplementation of electrolytes and water
- Rewarming quickly by infusion of warmed fluids and circulating warm air devices or blankets in case of cold exposure or hypothermia
- In case of processes with radiation hazard, the following measures can be taken:
  - Pre-employment and periodical medical examination
  - Personal monitoring badges
  - Pocket dosimeters and whole-body radiation counters
  - Monitoring radioactivity in the biological fluids
  - Removing a worker from the operations if radiation dose is exceeding the safe limit and monitoring for further effect`

Chemical Hazards Causing Occupational Diseases

- Gaseous agents and vapors: Gases such as methane and nitrogen released from mines and sewages can replace oxygen and cause asphyxiation.
- Carbon monoxide released in coal industry, steel furnaces, and vehicle exhaust fumes can bind with hemoglobin 200 times more rapidly than oxygen (Bluementhal, 2001).
- Hydrocyanic acid used in metal hardening, electroplating, and gold ore extraction may cause death in few minutes with cyanide poisoning.
- Solvents used in various industries can be inhaled and can cause bronchial irritation.
- Metals such as lead, mercury, manganese, and cadmium used in industries produce various undesirable effects.
- Dust and fibers: Respirable minute particles of 2 to 10 μm and thin filaments with length up to 100 μm can be inhaled and reach lungs causing tissue damage or asthma or even lung mesothelioma (WHO, 1999).
- Pesticides and chemical fertilizers can enter the body through the skin, GI tract, and inhalation.

Primary Prevention of Chemical Hazards

- Good housekeeping practices to reduce dust and fibers
- Adequate ventilation and fitting of exhaust fans
- Substitution of harmful chemicals with harmless chemicals
- Automation and mechanization of dusty processes
- Segregation and enclosing the dusty operations
- Provision of appropriate personal protective equipment such as mask
- Education of workers about the need for correct use of personal protective equipment

Biological Hazards

- Vegetables and plant products: Cotton fibers, sugarcane fibers, and flour coming out in the flour mill reach the lung and lead to occupational lung diseases.
- Pollen and tea dust allergy can cause bronchial asthma.
- Animal handlers and veterinarians are at a risk of contracting diseases such as anthrax.
- Healthcare professionals are at a risk of contracting various infections such as HIV, hepatitis B, and hepatitis C.

Primary Prevention

- Machines and dusty areas can be cleaned with cotton or other similar fibers can be cleaned using vacuum cleaners.
- Avoid dry dusting.
- Humidity of the spinning and clothing rooms can be increased.
- Prevent exposures to potential organisms such as anthrax.
- Avoid the dusty areas or pollen or other plant materials.
- Wear N95 masks.
- Wear other personal protective equipment.
- Employees at risk of contracting infection should be vaccinated.

Secondary Prevention

- In case of accidental exposure to organism, postexposure prophylaxis (PEP) needs to be initiated.
- There should be early detection and treatment of conditions such as byssinosis, bagossis, and occupational asthma.

Categories of Common Occupational Health Diseases

Occupational diseases can be grouped as follows based on the nature of health problems and the organs involved:
- Occupational lung diseases
- Occupational dermatoses

- Occupational cancers
- Work-related musculoskeletal disease
- Occupational injuries and accidents

Occupational Lung Diseases

Occupational lung diseases are diseases of the lung primarily occurring due to inhalation of dust particles or fibers that arise in the workplace/factories. They include the occupational asthma, pneumoconiosis arising from silicosis, asbestosis, or coal mine work, bagassosis, byssinosis, etc.

The report of National Programme for Control and Treatment of Occupational Diseases (2014) states that the prevalence of silicosis was highest among slate pencil workers (54.6%), followed by lead and zinc miners (30.4%) and foundry workers (27.2%). In mica miners, silicosis prevalence varies widely between 6.2% and 34%, and in coal miners, it was 9.3%. The report shows a high prevalence of byssinosis among cotton industry workers.

Industrial dust containing aerosol particles of size 1 to 100 μm gets dispersed in the air present in the work environment. Respirable dust with particles of size 2 to 10 μm can reach up to the alveolar region of the lung and get deposited there. Similarly, longer but slender particles or fibers of 2 to 5 μm diameter and with a length of 100 μm can reach deep into the lung, leading to fibrosis, and damage the lung. The dust gains entry into the respiratory system when there is natural air force as in cyclone or with mechanical processes (WHO, 1999).

Types of Dust/Fibers Causing Occupational Lung Diseases

- **Mineral dust:** Silica, coal, and cement dust
- **Metallic dust:** Lead, iron, aluminum, cadmium, nickel, etc.
- **Chemical dust:** Pesticides, chemicals, and paints
- **Biological dust:** Live organism, spores, and mold
- **Agricultural and plant dust:** Flour, wood, cotton, hemp, and tea dusts, pollens, and sugarcane fibers

Industries Associated With Dusty Processes

- Mines—quarrying and tunneling
- Cement industries
- Stone carving and sculpturing
- Building construction and demolition
- Pencil slate industry
- Foundries and other types of metallurgical activity
- Shipbuilding (abrasive blasting)
- Manufacture of glass, ceramics (pottery, porcelain, and enamel), and stone objects
- Manufacture of cleansing agents and abrasives
- Chemical and pharmaceutical industry (handling of powdered chemicals)
- Rubber manufacturing industry
- Manufacture of lead storage batteries (bulk lead oxide)
- Flour mills, bakery works, and salmon processing unit
- Fertilizer industry
- Paint industry, spray painting, and glass painting
- Agricultural industry (ploughing, harvesting, grain storage)
- Sugarcane industry
- Forestry and woodworking

Pneumoconiosis

It is a type of occupational lung disease. The ILO defines pneumoconiosis as "accumulation of dust in the lung and the tissue reaction to its presence." It is an umbrella term that includes various types of pneumoconiosis such as silicosis, coal workers' pneumoconiosis (CWP), asbestosis, byssinosis, and bagassosis. The generalized scheme of pathophysiology of pneumoconiosis is presented in Figure 64-2. The minor differences in the pathophysiological sequences and clinical features and the type of industry involved are presented in Table 64-1. An elaborate discussion on silicosis and asbestosis is present in the following section.

Silicosis

Silicosis is a progressive interstitial lung disease, characterized by shortness of breath, cough, fever, and bluish skin, and can present in three different forms: acute, accelerated, and chronic.

Magnitude of the Problem

Silicosis and silicotuberculosis are very common among developing countries. In India, they are a major occupational menace that needs to be tackled effectively. As many as 1.7 million workers involved in mining or quarrying, 0.6 million workers in the nonmetallic industries such as clay, glass, and mica, and 0.7 workers in the metal industry are at a high risk of silicosis. Apart from this, nearly 5.3 million workers involved in construction works are also at risk. Agate grinding industry and pencil slate manufacturing industry found uniquely in India pose a high risk for the workers in those factories (ICMR Bulletin, 1999) (Sharma, Kundtu, et al., 2016). The WHO and the ILO have initiated the silicosis eradication program in the year 1999. Many countries have national program for silicosis eradication.

Pathophysiology

Silica is naturally available in enormous quantity in the earth's crust. While drilling, blasting, and explosion of earth, the

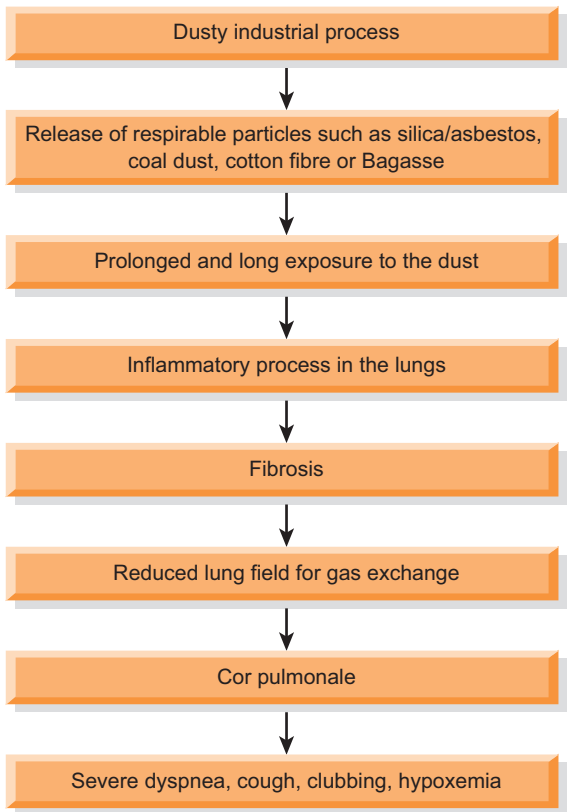


Figure 64-2 • Pathophysiology of pneumoconiosis.

TABLE 64-1 Pneumoconiosis of Different Etiology and Their Clinical Picture at a Glance

Type of Pneumoconiosis (Industries)	Pathophysiological Process	Clinical Features
Silicosis (glass manufacturing, foundry, stone cutting, agate grinding)	Inhaled silica dust produces nodular lesions in the lungs. Nodules enlarge and coalesce. Dense masses form on the upper portion of lungs, resulting in loss of pulmonary volume. Fibrotic destruction of pulmonary tissue can lead to restrictive lung disease, emphysema, pulmonary hypertension, and cor pulmonale	• Acute silicosis: Dyspnea, fever, cough, weight loss • Chronic silicosis – Progressive symptoms indicative of hypoxemia – Severe airflow obstruction and right-sided heart failure
Asbestosis (ship building, building demolition)	Inhaled asbestos fibers enter the alveoli and are surrounded by fibrous tissue. Fibrous changes can also affect the pleura, which thickens and develops plaque. These changes can lead to restrictive lung disease, with a decrease in lung volume, diminished exchange of oxygen and carbon dioxide, hypoxemia, cor pulmonale, and respiratory failure. They also increase the risk of lung cancer, mesothelioma, and pleural effusion	Progressive dyspnea; persistent, dry cough; mild to moderate chest pain; anorexia; weight loss; malaise; clubbing of fingers
Coal workers' pneumoconiosis (coal mine)	It is also known as black lung disease. Inhaled dusts that are a mixture of coal, kaolin, mica, and silica are deposited in alveoli and respiratory bronchioles. When macrophages that engulf the dust can no longer be cleared, they aggregate and fibroblasts appear in the bronchioles and alveoli can become clogged with dust, dying macrophages, and fibroblasts, leading to the formation of coal macules. Fibrotic lesions develop and subsequently localized emphysema develops, with cor pulmonale and respiratory failure	Chronic cough, dyspnea, and expectoration of black or gray sputum, especially in miners who are smokers with cavitation in the lungs
Byssinosis—brown lung (textile industry, cord clothing manufacturers, hemp industry)	Vegetable fibers such as cotton, hemp, and sisal fibers get into the lung, and cause inflammation, wheezing, and chronic bronchitis	Initially milder symptoms on assuming work after weekend, called "Monday feeling" Chest tightness, cough, wheezing, and severe breathing difficulty
Bagassosis—farmer's lung (sugarcane industry, agricultural industry)	Thermophilic actinomycetes found in decaying hay, compost, and sugarcane, especially in winter seasons, liberate a lot of dust. Exposure to allergens present in decomposing sugarcane or hay stimulates cell-mediated and humoral immunity. Neutrophilic and lymphocytic infiltration with prolonged exposure causes destruction of alveolar unit, collagen deposition, and destruction of lung parenchyma; pulmonary fibrosis occurs	Chills, fever, cough, and running nose usually in damp, winter seasons when the individuals handle decaying hay or sugarcane Later, severe breathlessness, crackling sounds, and reduced lung function

fine particulate silica is emanated. The workers in the mining industry, furnace, pottery, ceramics, mica mines, etc., are at a risk of developing silicosis. Silica is available in various sizes and forms. The crystalline silica is notorious for causing silicosis and silica tuberculosis. Fine dust with silica particle size less than 7 mm diameter is called respirable silica (Rees & Murray, 2007).

When respirable crystalline silica is inhaled, it reaches the lung usually in the upper lobes. Since silica is a nonirritant, it may not cause symptoms initially. After 10 to 20 years of exposure, chronic silicosis develops. In some susceptible people, silicosis develops after 3 to 5 years of exposure. In very few individuals, with large inhalation of silica dust, the clinical picture worsens in a short span of time causing an accelerated form of silicosis. Initially, the hilar lymph nodes are involved with lesions measuring 3 mm in diameter. As the disease progresses with prolonged exposure, the nodules may be found in the mid and lower lobes. The respirable silica dust gets accumulated and produces an inflammatory reaction with proteinolysis and fibrogenesis with inflammatory markers lymphocytes and macrophages. As the disease progresses, nodules coalesce with adjacent lung parenchyma and lead to development of massive fibrosis of the lungs. In acute and accelerated forms, the severe inflammatory reaction happens with exposure of a shorter duration, even few months of exposure. The inflammatory changes are mediated through type II pneumocytes. These hypertrophic pneumocytes may produce excessive amounts of proteinaceous material and surfactant protein, and the alveoli may then get filled with a protein-containing material. The nodules contain more of cellular eosinophilic granular material with less fibrotic changes.

Clinical Features

These include dyspnea, fatigue, weight loss, fever, and pleuritic pain. Pathological changes consistent with acute silicosis include the filling of alveolar spaces with eosinophilic granular material, similar to that observed in accelerated silicosis. Chronic silicosis is commonly present with emphysema and tuberculosis as a superadded infection.

Diagnosis

- History of occupational exposure to silica
- Clinical examination and chest X-ray
- Demonstration of silica particles during bronchoalveolar lavage

Management

Silicosis is progressive and incurable. The aim is to monitor the workers on a regular basis with physical assessment, X-ray chest, spirometry, and screening for TB. If anyone is found

to have silicosis, relocation of jobs to less dusty works or similar measure may be helpful. If superadded TB is present, antituberculosis drugs are prescribed.

Primary Prevention
- Education and creating awareness about the preventive measures
- Pre-employment and periodic checkup

Asbestosis

Asbestosis is an occupational lung disease characterized by severe shortness of breath and dry cough, mainly because of interstitial lung fibrosis with decreased diffusing capacity due to deposition of asbestos fibers in the lungs.

Asbestos is a naturally occurring, thick, hydrated silicate that is found as fibers of different shapes and sizes. Two distinct forms of asbestos fibers have a clinically significant impact. The curly, thin, flexible fibers are called serpentine and the short, straight, brittle fibers are called amphiboles.

Magnitude of the Problem
The ILO has predicted that 1 million people will die due to asbestos-related cancers by 2020. The situation in India is the worst with a huge burden of 10 million people with exposure to asbestos (Jadhav & Roy, 2012). The WHO and the ILO have called for the prevention of asbestos usage. Most of the countries have banned the usage of asbestos, but in India the utilization of asbestos has not come down.

Pathophysiology
The asbestos fibers are inhaled along with air in occupational settings such as asbestos factory, ship building, demolition of buildings, and mines, and a respirable fraction of fibers reaches the alveoli of both the lungs. The severity of the disease depends on the shape and size of the inhaled particles, the duration of exposure, and the dustiness of the processes. Lifestyle such as smoking adds to the risk.

Some fibers that got trapped in the upper airway may be cleared by mucociliary action and cough mechanism. But all the fibers may not get eliminated. The stiff amphibole fibers with diameter less than 0.5 μm and length less than 10 μm are highly dangerous as they can reach the deeper areas of the lung and penetrate the interstitial layer. Usually, the lower lobe is affected. In an attempt to eliminate the asbestos fibers, the alveolar inflammatory mechanism is initiated. The macrophages try to engulf and neutralize them. The chemotoxic and fibrogenic mediators are released to eliminate the fibers.

Chronic exposure and inhalation of the asbestos for 10 to 20 years in the industrial setting lead to diffuse interstitial inflammation of the lung and destruction of lung architecture. Fibrogenic mediators released in the inflammatory process result in diffuse fibrosis, causing restrictive lung changes. The ingested fibers get coated with iron and protein material and stay in the fibrosed area of the lung with a golden yellow–colored, bead-like appearance. The patient may develop pulmonary hypertension and cor pulmonale as a sequela of excessive fibrosis.

Clinical Features
- Severe dyspnea
- Dry cough
- Respiratory crackles
- Clubbing of fingers

Diagnosis
- Spirometry
- Chest X-ray
- High-resolution CT of thorax

Management
As the disease is progressive in nature, only symptomatic relief is possible. Oxygen may be administered. Wearing a protective mask, adequate ventilation, reducing the exposure by environmental control, and quitting smoking help in the prevention of the disease.

Prevention and Control
A three-level strategy for effective control and prevention has been suggested (Cullinan, Munoz, Agius, et al., 2017). High priority is given to elimination of dust followed by substitution of dust. The third priority in order is given to occupational hygiene measures. Administrative control and application of personal protective equipment are given a low priority. Asbestos, which is a highly toxic dust, can be replaced with a less toxic, man-made mineral fiber called rock wool (Cullinan et al., 2017). Enclosing a dusty operation prevents dispersion and inhalation of dust.

Occupational Asthma

Occupational asthma is a disease characterized by variable airflow limitation and/or airway hyperresponsiveness due to causes and conditions attributable to a particular occupational environment and not to stimuli encountered outside the workplace (Mapp, Boschetto, Maestrelli, et al., 2005). Occupational asthma accounts for 15% of all adult asthma cases in the developed nations. One in 10 cases of adult-onset asthma or recurrent asthma in adulthood is attributable to work (Nicholson, Cullinan, Taylor, et al., 2005). Prevalence of occupational asthma was found to be 20.83%, of which 29.16% of participants were suffering from bronchial asthma in a silk factory in southern India (Gowda, Vijayeendra, Sarkar, et al., 2014).

Causes
Agents that are most common to cause allergic asthma are isocyanates, aldehydes, flour, grain, dust, colophony, fluxes, animal fur and urine, latex, and wood dust (Nicholson et al., 2005; Reid and Reid, 2013).

Pathophysiology
More than 90% of workmen develop asthma, which is called occupational asthma. Some individuals who have asthma already may have exacerbation of asthma at work. It is called work-aggravated asthma. Typically, there is a latent period after allergic exposure to symptom development in occupational asthma. It is usually immunoglobulin E (IgE) mediated. A small proportion of workers (<7%) may develop asthma in a single episode with a high quantity of exposure to an irritant at the workplace (Mapp et al., 2005).

The mineral, metallic, agricultural, or animal particulate dusts when inhaled or exposed give rise to an allergic reaction and subsequent bronchospasm, wheeze, and breathlessness. Employees who develop rhinitis on occupational exposure are at a risk of developing occupational asthma. A flowchart depicting pathogenesis of occupational asthma is presented in Figure 64-3.

Diagnosis
History. Patients give a history of adult-onset asthma, feeling better when on holidays and worsening during the working days. In health history, try to elicit the factors that improved asthmatic spells rather than the worsening factors (Nicholson et al., 2005).

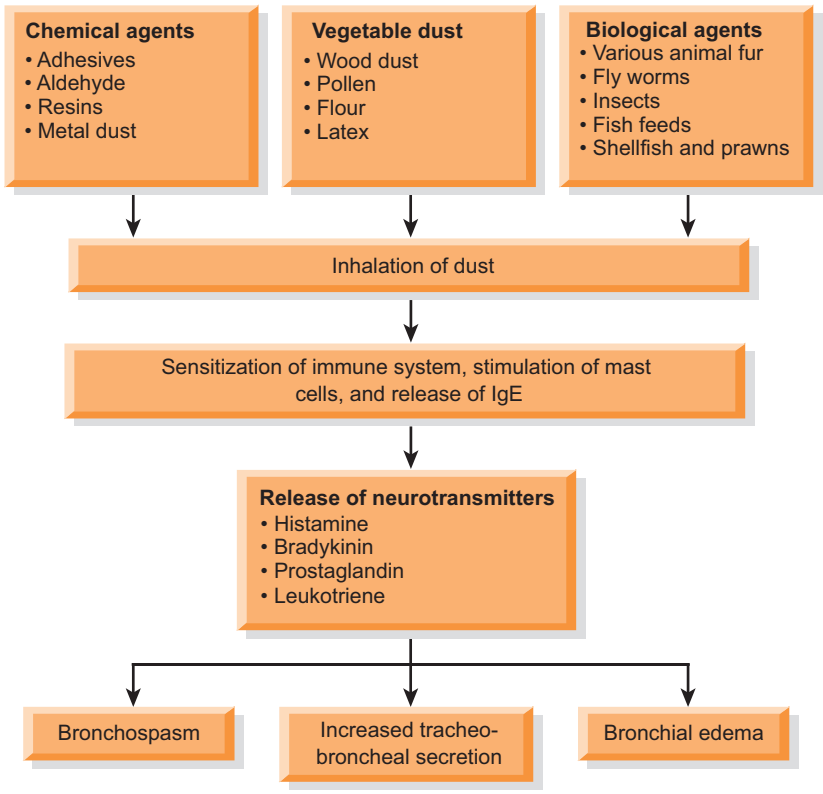


Figure 64-3 • Pathogenesis of occupational asthma.

On investigation, patients may show elevated IgE for a specific irritant inhaled or exposed. Peak expiratory flow rate may improve during holidays. Specific allergens can be injected to elicit the allergic reaction. The severity of asthma varies based on the quantity and length of duration, individual immune status, and susceptibility.

Prevention and Control

- Early identification and avoidance of the allergic agents yields a good prognosis.
- Respiratory protective equipment should be worn appropriately.
- There should be periodical medical checkup and surveillance for occupational asthma for all employees. Frequent surveillance is recommended for those who develop rhinitis (Nicholson et al., 2005).
- Employees should be educated about the need for wearing a protective mask while at work.

Nursing Management

- Nursing management is very similar to care of a patient with asthma.
- Collect data regarding allergic exposure and the quantity of allergen.
- Elevate the head end of the patient and support with cardiac table.
- Monitor vital signs.
- Administer the prescribed bronchodilators, mast cell inhibitors, leukotriene modifiers, and other β-agonists. Administer the prescribed low-flow oxygen and nebulizer therapy as indicated.
- Encourage adequate oral intake of warm water and other warm fluids.
- Encourage to perform pursed lip breathing and coughing.
- Evaluate the effectiveness of therapy.
- Educate about the perfect way of wearing a protective mask and encourage the measures to avoid allergic exposure.

Occupational Dermatitis

Occupational dermatitis is a pathological condition occurring in the skin due to occupational exposure resulting in noninfectious inflammation of the dermis. On examination, the skin lesions occurring on occupational chemical exposure may mimic those of eczema (Foulds, 2005).

Prevalence rate of occupational dermatoses is 7.1% in Europe, 2.5% in Vietnam, and 11% in Thailand. Pesticide-induced dermatosis is common in India with a prevalence rate of 26.7% to 36.6% (Bhatia & Sharma, 2017).

Different kinds of chemicals such as caustic soda, petroleum, and chromium can cause occupational dermatitis. Certain factories or workplaces sites are identified to cause dermatitis among the workers in those factories (Foulds, 2005).

Occupations Known to Cause Occupational Dermatitis

- Glass and porcelain works
- Vehicle assembly line works
- Spray paint works
- Machine tool operation
- Construction and electroplating industry
- Leather tanning industry
- Printing synthetic clothes
- Fertilizer industry
- Petrol refinery units
- Agricultural industry

Pathophysiology

Whenever the chemicals or irritants come in contact with stratum corneum (horny layer), the lipid present on that layer is removed. With repeated exposure to irritants, the keratin from the skin layer is also removed, leading to itching, dry scaling,

and blister formation. This type of dermatitis is called irritant dermatitis.

Some allergens get dissolved and enter the body to combine with mast cells. The mast cells then liberate kinins and histamine, resulting in allergic contact dermatitis.

Clinical Features

- Itching and irritation in the skin
- Dry, scaly skin with small blisters
- Pain
- Weepy skin
- Distribution of the skin lesions mostly in the hands, forearm, and face as these parts are more often exposed to potentially chemicals
- With cracks and aberration in the skin, superadded infection is also possible
- Worsening of symptoms in case of infection
- Discharge from the skin lesions
- Fever and increase in pain

Prevention

- Avoid exposure to irritants and allergenic chemicals and industries.
- Cleanse the skin after exposure. Cleansers should be soft but effective to remove the chemicals in a short period of time without having a too strong greasy effect (Foulds, 2005).
- Topical application of barrier cream should be done.
- Wear personal protective items such as mask and glove. For detailed patient education, refer Chapter 34, Chart 34-3.

Management

- Application of barrier cream containing ceramide or dimethicone may be done.
- Corticosteroid cream also may be useful.
- Encourage protective device application such as gloves or aprons and mask according to the nature of possible exposure and the agents.

Occupational Cancer

Definition

Occupational cancer is any malignancy wholly or partly caused by exposures at the workplace or in occupation (Veys, 1996). There are numerous hazardous agents present in the work environment capable of causing minor ailments and even leading to development of cancers. There are a lot of carcinogenic agents in the work environment, which include hexavalent chromium salts, asbestos, arsenic, benzene, beryllium, cadmium, chromium, diesel exhaust, ethylene oxide, respirable quartz, and ionizing radiation (Veys, 1996). Benzene is a commonly used chemical in industries and is a highly potent carcinogen (Wiwanitkit, 2014). Different industries emit or use different kinds of chemicals and the type of cancer caused also varies accordingly.

Magnitude of the Problem

As per the ILO predictions, 20 million people will be afflicted by asbestosis-related cancer by 2020. In India alone, 10 million people are expected to develop cancer due to excessive exposure to asbestos (Jadhav & Roy, 2012). Among the different asbestos fibers, the amphiboles are found to be associated with mesothelioma. Study findings suggest that firefighters are at risk of inhalation of benzene in the process of combustion, which was shown to increase the risk of leukemia, myeloma, and non-Hodgkin lymphoma (Guidotti, 2007). Leather industry uses various chemicals for tanning and processing such as chromium, benzene, and dimethylformamide. The risk of lung cancer increases with exposure to chromium and benzene. Pancreatic cancer was shown to be high in women who were exposed to chemicals such as formaldehyde, aniline, and azo dyes in leather industry. Testicular cancers in leather industry workers were found to be caused by dimethylformamide (Rastogi, Kesavachandran, Mahdi, et al., 2007).

Healthcare professionals working in the radiation therapy, radiology department, and endoscopy room are at a risk of cancer. Glutaraldehyde and formaldehyde used in the clinical setting have the potential to cause cancer (Gannon, Bright. P., Campbell, et al., 1995). Similarly, those who are involved in preparation and handling of chemotherapeutic drugs on a regular basis are at a risk of skin contact with the potentially hazardous chemicals, and if not protected by masks, inhalation of the drug molecules is possible. Viral agents such as HIV, HBV, and HCV can be occupationally transmitted to healthcare professionals. HIV and HBV are associated with Kaposi sarcoma and liver cancer, respectively.

Occupational cancer presents with symptoms and pathological changes very similar to those in patients with nonoccupational exposure cancer. But certain agents are positively associated with a certain type of cancer based on the causality studies (Veys, 1996).

Primary Prevention

- Avoid direct exposure to known carcinogens.
- Wear appropriate personal protective equipment to prevent inhalation of mineral and metallic dust. Ensure that the mask chosen is capable of filtering the minute respirable particles.
- Avoid exposure to ionizing radiation. In case of systemic radiation therapy, cluster the interventions and limit entry to patient care area.
- Wearing protective jackets, gloves, mask, etc., is mandatory.

Work-Related Musculoskeletal Injuries/Diseases

Musculoskeletal disorders can be defined as injuries and disorders of the muscles, nerves, tendons, ligaments, joints, cartilages, and spinal disc that occur due to work activities or factors in the working environment. Work-related musculoskeletal disorders are the most common cause of absenteeism and poor quality of life. Poor ergonomic factor is an important cause of musculoskeletal disorders.

Ergonomics applies the integrated knowledge of human science such as anatomy, physiology, and psychology to match the job, systems, products, and environment to physical and mental capabilities and limitations of the worker. In short, it is fitting the job to the worker.

Causes and Risk Factors

- Works involving lifting heavy weights, pushing, and pulling
- Works that require frequent bending and twisting
- Heavy physical work
- Working in the same posture for a long time
- Repetitive work
- Vibration
- Poor working ergonomics
- Psychosocial stress

Commonly Affected Population

- Construction workers
- Automotive industry
- Steel industry workers
- Nurses and other healthcare workers
- Workers involved in truck loading and unloading
- Computer operators and IT professionals

Pathogenesis of Work-Related Musculoskeletal Diseases

Lots of factors lead to the development of occupational musculoskeletal diseases. Personal factors such as aging, poor coping ability along with repeated mechanical load, poor ergonomics while handling weight manually, and psychological stress and shear lead to pain in the back, neck, etc., which in turn adds up the stress and hastens the process of development of musculoskeletal diseases. Modernization of offices has led to different work atmosphere. The computer professionals and data entry operators work with small muscles of the upper arm. The neck and the back get strained because of keeping an awkward posture for a long time. Similarly, the small muscles of the fingers are overstrained while using the keyboards. Wrist is made up of tiny carpal bones arranged in a unique way making it like a tunnel through which the tendons of the forearm muscle along with median nerve traverse. Repetitive movements lead to inflammation of the tendon and the median nerve gets compressed. This condition is called carpal tunnel syndrome. The quantum of injury depends on the time or duration of hours spent working on computers. Majority of computer users reported neck pain, shoulder pain, and tingling in the extremities (Subrathy and Korumtollee, 2005). The causes of shoulder and neck pain could be poor workstation, the improper nature of chair, etc. More than 20 minutes of break in between work and a thorough stretch were found to be helpful in reducing shoulder and back pain. The pathophysiology of work-related musculoskeletal disorders is presented in Figure 64-4.

Common Work-Related Musculoskeletal Problems

- Tension neck syndrome: Common among employees in IT field
- Cervical syndrome
- Thoracic outlet syndrome
- Lumbar disc prolapse

} Common among nursing personnel and truck drivers

- Carpel tunnel syndrome: Inflammation of the small joints and tendons with repetitive movements of small joints and fingers and abuse lead to tenosynovitis or carpel tunnel syndrome. These type of injuries are commonly found in computer professionals, data entry operators, blacksmiths, and goldsmiths. Patients may suffer from weakness, numbness of the hands, decreased hand grip, and pain (Subrathy & Korumtollee, 2005) (Ghosh, Das, & Gangopadhyay, 2011).

Assessment

The patient may give a history of repeated manual handling of weight. The patient may present with severe pain in the low back, which may radiate to thighs and legs; certain positions or activities such as bending may aggravate the pain. An X-ray may show degenerative changes and prolapse of one or more lumbar disc. MRI may also reveal intervertebral disc herniation.

Collaborative Management

Back pain in the initial phase can be managed with pelvic traction and analgesics. NSAIDs and mild antidepressants or sedatives may be prescribed. Hot applications may improve comfort. If the nerve root compression with complete disc herniation results in neurological deficit and limitation in movements and walking, surgical intervention is recommended. Common perioperative nursing management details are presented in Chapter 6.

The commonly encountered nursing diagnoses may be the following:

- Acute low back pain related to compression in the intervertebral disc or/and nerve roots
- Ineffective coping related to pain
- Impaired physical mobility related to pain and reduced muscle power in the lower limbs/surgical trauma
- Anxiety related to unexpected outcome of surgery

Nursing Management

If there is acute low back pain related to compression in the intervertebral disc or/and nerve roots, assess the pain intensity

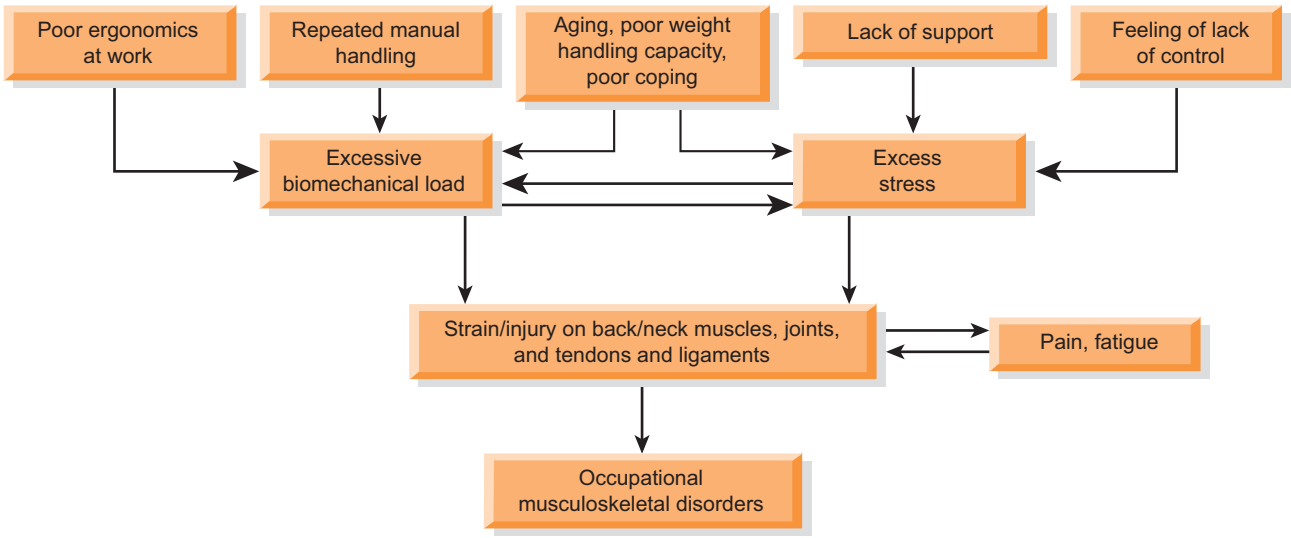


Figure 64-4 • Pathophysiology of occupational musculoskeletal disorders.

and nature. Administer the analgesic agents as prescribed. Encourage the patient to maintain appropriate body alignment while sitting and standing. Encourage the patient to perform isometric exercises to strengthen the back muscles. Educate the patient regarding yoga, relaxation therapy, imagery, or other diversional therapies. Apply a hot water bag. Provide complete bed rest. Encourage the patient to avoid bending or twisting movements. Monitor the effectiveness of pain relief measures periodically.

If the patient is in the postoperative phase following lumbar disc surgery, apply log roll technique for turning the patient. Use of striker frame may help in position change without disturbing the operated site, but with ease and comfort. All other pain relief measures except hot application and traction may be implemented.

Prevention of Work-Related Musculoskeletal Disorders

- Adhere to principles of biomechanics and automate the manual processes of strenuous lifting, pulling, and pushing activities.
- Take measures to enhance the physical fitness and coping such as provision of fitness studio and creating a culture that promotes exercises and positive behaviors.
- Initiate measures to reduce psychosocial factors. Have positive work milieu where everyone's contribution is acknowledged appropriately. Transparency in work and reward allocation will help in reducing conflicting situations.
- Allow for small breaks of 20 minutes in between the long monotonous working hours.
- Those who are aging may be transferred to less strenuous jobs.

Occupational Musculoskeletal Problems Among Nurses and Health Workers

Musculoskeletal problems, especially back injuries, neck injuries, and spinal disc problems, can be debilitating to nurses. The nursing job demands manual handling of patients on a regular basis throughout their career. Realizing the impact of musculoskeletal problem on occupational health of nurses, the ANA has launched a campaign named "Handle With Care" in 2003. The aim of this campaign is to initiate consolidated effort to reduce the risk of musculoskeletal injuries faced by nurses. The campaign seeks to educate, advocate, and facilitate change from traditional practices of manual patient handling to emerging, technology-oriented methods (de Castro, 2004). The campaign seeks to reduce the work-related musculoskeletal injury through collaboration with stakeholders to promote assistive devices in healthcare facilities. Another important aspect is to bring awareness to the nurses and young student nurses on appropriate and safe handling techniques. The aim is to safeguard patients as well as nurses.

Although nursing curricula include the principles of biomechanics and the application in nursing, accomplishment of the necessary skills is questionable (de Castro, 2004). Patient condition also adds to the problem. Unconscious patients, patients on mechanical ventilation, postsurgical patients, and patients with spinal injuries could offer no effort to nurses in mobilizing them. Morbidly obese patients add up the risk of musculoskeletal injury to nurses.

The National Institute of Occupational Safety and Health (NIOSH) proposed a lifting equation, according to which the safe limit for manual handling of weight is no more than 23 kg. It may not be suitable in the nursing care situation. The amount of cooperation that a patient can yield from his or her side varies (de Castro, 2004).

TABLE 64-2 Safe Patient Handling Equipment and Devices

- Inflatable lateral assist devices
- Standing and raising aids for those who have difficulty in standing up
- Repositioning sheet in bed, which facilitates repositioning of bedfast patients
- Ceiling lifts that can lift patients from bed and transfer those highly dependent patients
- Sling lifters that can safely lift patients from floor or chair or bed
- Lateral transfer slings
- Specially designed high-powered bariatric lift devices

Nelson and Baptiste (2004) emphasize the need for a major paradigm shift away from ineffective approaches toward the following evidence-based practices: (1) patient handling equipment/devices, (2) patient care ergonomic assessment protocols, (3) no-lift policies, (4) training on proper use of patient handling equipment/devices, and (5) patient lift teams.

Even with patient-lifting devices, the amount of time nurses spend on preparing the patient for transfer in the bending posture needs to be considered. Among the patient-lifting devices, ceiling lift devices are effective than floor lift devices (Kuijer, Verbeek, Visser, et al., 2014) (see Table 64-2). Various safe patient handling equipment and devices are presented in Figure 64-5.

Pretransfer Assessment Recommended by Nelson and Baptiste

- Assess the ability of the patient to provide assistance.
- Assess the weight-bearing ability of the patient.
- Check for the upper extremity strength of the patient.
- Assess the ability of the patient to cooperate and follow instructions.
- Find out the patient's height and weight.
- Assess for the presence of abdominal wounds, contractures, or tubes that affect repositioning tasks.
- Look for specific physician orders or physical therapy recommendations that relate to transferring or repositioning patients such as those with knee or hip replacement.
- Assess whether the surface is even and nonslippery.

Tips for Nurses to Avoid Work-Related Musculoskeletal Injury

- Get help from other personnel or assist devices. Never try to lift or manually handle patients alone.
- Be mentally and physically prepared for manual handling of patients.
- Give appropriate instructions to your helpers for smooth and coordinated movements.
- Ensure that the floor is nonslippery and obstacle free. Avoid high-heel, slippery *chappals* while at work.
- Use the principles of good body mechanics while handling patients manually.
- Have a wide base of support with legs firmly footed on the ground.
- Avoid twisting or bending at the hip level.
- Use large muscle groups rather than straining the small muscles.
- While transferring patients from bed to stretcher, see that the bed and the stretcher are kept at the same height to avoid extra workload.



A



B



C



D

Figure 64-5 • A. Ceiling lifts. **B**. Standing raising aid. **C**. Passive sling lifter. **D**. Passive floor lifter. Courtesy: Arjohuntleigh Healthcare India Ltd.

- The bed height has a great bearing on kinematics, so height of the bed at hip level is helpful to reduce strain on the L5, S1 area (Roy, Lortie, & Roy, 1988).
- While pushing the patient forward, have the front leg forward, which will increase the base of support.
- While pulling the patient backward, move one leg one step back to increase the base of support.
- Instead of working against gravity, try pushing or pulling.
- Keep the patient to be moved as close to you as possible.
- When the back is kept straight with proper alignment of the back, neck, shoulders, and chest, the center of gravity will fall within the base of the support and strain on the back muscles or ligaments will be minimal.

Occupational Injuries and Accidents

Major accidents happen at workplaces. The Bhopal gas tragedy happened in the Union Carbide factory in Madhya Pradesh, India, in 1984; Chernobyl atomic reactor blast in the USSR had recorded mass fatalities not only to the workers but also to the inhabitants of the localities surrounding those factories. As per the Ministry of Labour, Government of India (2017), the fatal accident rate in the coal mines was 0.18 per 1,000 employees, and in the non–coal mines, it was 0.24 per 1,000 employees.

Causes of Accidents

- **Administrative factors**
  - Default or malfunctioning machines
  - Inadequate workman strength
  - Improper design and engineering
  - Inadequate training to employees
  - Lack of supervision
- **Employee factors**
  - Poor awareness about the risky processes and hazardous substance
  - Nonadherence to safety control mechanism/safety personal protective equipment, sometime due to overconfidence
  - Deadline-oriented work
  - Fatigue factor and oversight
  - Faulty operations
  - Too much diversion of attention from work process
- Sudden default in gadgets

Primary Prevention

- Periodical checking of the functional status of the machines and removing the worn-out ones from operations
- Standardizing the operation and processes
- Regular induction programs for new employees

- Measures to avoid human factor of fatigue, etc., by providing proper working conditions and amenities
- Installation of alerting devices in the event of faulty operation releasing dangerous chemicals or fumes or fire
- Automation of dangerous operations
- Reengineering industries and factories for safe work environment

Occupational Risks for Nurses and Healthcare Workers

Healthcare workers, especially nurses, face a multitude of hazards in their work:

- Musculoskeletal injuries or diseases
- Exposure to microbial agents leading to infections such as HIV, HBV, HCV, and TB
- Exposure to chemical agents such as glutaraldehyde and formaldehyde that can lead to occupational asthma or occupational dermatitis, and contact or inhalation of chemotherapeutic agents
- Radiation hazards

Prevention of High-Risk Occupational Infection Among Nurses/Health Professionals

- Adherence to standard precautions and wearing appropriate personal safety wears such as gowns, masks, gloves, and goggles
- Adherence to hand washing/hand hygiene protocol
- Following biomedical waste management protocol
- Vaccination to diseases such as HBV, TB, seasonal flus, swine flu, bird flu, or varicella
- Precaution while handling sharps and needles
- Not recapping needles
- Discarding used needles in puncture-proof containers
- In case of sharp injury with needles or scalpel contaminated with HBV- or HIV-positive patients, following PEP protocols with antiretroviral agents in case of HIV and immunoglobulin in case of HBV
- Following appropriate sterilization and disinfection protocols including the environment
- Maintaining general well-being and nutritional status

Post exposure Prophylaxis

Body fluid exposure on a nonintact skin or mucous membrane or a sharp injury with a used needle or scalpel or other sharps poses a danger of acquiring blood-borne infections such as HIV, HBV, or HCV. If you know the health status of the patient for whom the needle or sharp was used, appropriate action has to be taken. The infection control nurse has to be informed and appropriate prophylaxis has to be taken. Refer Chapter 55 for a detailed discussion on PEP (Chart 55-6).

Occupational Health Program in India

For strategic prevention of occupational diseases, occupational health program is initiated by the Government of India in collaboration with the WHO and the ILO. Success of occupational health program depends on the cooperation and coordination of government, law-enforcing authorities, industrial organizations, and their employees. Certain regulations and laws are enacted to prevent the ill effects of occupational health hazards such as asbestos abatement regulation and radiation inspection program. Education and awareness of occupational diseases, air quality checks, and noise containment are some efforts initiated collaboratively to improve occupational health.

Employers' Responsibilities

- Follow safety guidelines set forth periodically by the safety council or legislation.
- Provide adequate awareness and education to the employees about the prevailing hazards in the industrial setting.
- Assess the air quality and relevant parameters as recommended and keep vigilance not to cross safety limits.
- Initiate engineering and ergonomic measures to mitigate the negative effects of work hazards.
- Arrange for pre-employment check and periodical health checkups.
- Provide facility for first aid/emergency care and further management either by setting up own medical facility or by third-party arrangement.

Employees' Responsibility

Safety and health is not just for specialists and professionals. It should become the concern of all people at workplaces. We have to collectively develop the conscience of the common people (Mahadevan, 2009). Employees have a great role to play in ensuring occupational safety and to promote occupational health. An employee is expected to:

- Follow the safety guidelines while at work.
- Take active part in ensuring safety and healthy work environment.
- Be aware of the hazards present in the work environment and consistently wear personal protective equipment.
- Sensitize the fellow workmen and employers in case of any unsafe gadgets or malfunctioning machinery or work process occurring in the industrial setting.

Role of Health Team Members

A physician plays a vital role in early detection and appropriate management of the workers affected by occupational diseases. He/she participates in health research and organizes and coordinates unit-based or industry-based surveillance.

Nurses' Role in Occupational Health Program

Occupational health nurses are the largest group of health professionals engaged in the provision of safe health services to working population in many countries in the world (Whitaker & Baranski, 2001). In India, the occupational/industrial nursing is now gaining momentum with many corporates starting employing occupational health nurses along with occupational physician. Traditionally, the occupational nurses work in the hospital or healthcare units of the factories and provide secondary prevention services. Occupational nurses in India are now involved in disease management, environmental management, conduction of safety audits, and hearing preservation initiatives apart from first aid training (Priolcar, 2013).

Occupational health nurses carry out various aspects of the occupational health services starting from maintaining data pertaining to occurrence of occupational disease/injuries, planning, implementing, and evaluating the effectiveness of the appropriate intervention. They play several roles in the occupational health, which include specialist nurse, manager, coordinator of occupational services, advisor, health educator, counselor, and researcher (Whitaker & Baranski, 2001; Priolcar, 2013).

An occupational health nurse administers occupational health services within the legal and professional framework. The nurse's role in occupational healthcare delivery includes the following:

- Conducts periodical health checkup and organizes screening program for the workers
- Assesses the vital environmental parameters to identify any threat to health
- Initiates primary prevention by modifying the work environment or changing the workplace
- Identifies emergencies and provides first aid
- Delivers curative and rehabilitative services in collaboration with the other health team members
- Identifies the risks in the industry and provides advice and information to reduce risk
- Maintains environmental health, thereby playing a role in safeguarding the general well-being of the people living in the communities adjacent to industries
- Advises small- and medium-scale entrepreneurs on methods to contain or reduce risk
- Provides counseling and guidance to workers on complex health issue

Indian Perspective of Occupational Health and Occupational Health Program

As per the National occupational safety and health profile (2015), there are 350,000 registered factories in India in which around 15 million workers are employed. Besides that, there is a huge number of people working in unorganized sector and small scale industries. In the recent years, there has been 10% increase in female workers. Based on the provisions of the Factories Act and the Mines Act of the Government of India, only 10% of the workforces are ensured of health and safety at work and the remaining 9.0% of the workers fall in unorganized sector and still at risk of handling dangerous chemicals and operations. High proportion of workers in unorganized sector and increase in female workers' population have posed a lot of challenges in ensuring optimal occupational health.

The occupational health is still under the purview of the Ministry of Labour and is not under the Ministry of Health. The Directorate of Industrial Safety and Health at state levels implements the occupational health activities through factory inspecting engineers and medical inspectors of factories. Workers in the mining industry, factories, and ports and construction laborers are presently covered by the occupational healthcare delivery system. The port workers are covered by the port trust hospitals located in various ports. Mine workers and factory workers such as those employed in integral coach factories, Bharat Heavy Electricals Limited, and railways are covered by their own health centers. The Employee State Insurance Corporation (ESIC) is a huge organization that provides curative services to around 8 million employees (Occupational health and services-Indian scenario, see Resources section). An industry with an employee strength of 100 or more must have an occupational health center with a full-time occupational physician. If a unit has less strength, it is covered under ESIC but it is not provided with the preventive services.

National Occupational Health Policy on Safety, Health, and Environment at Workplace

The national occupational health policy proclaims that the occupational health and provision of safety at workplace are fundamental rights of workers. The national health policy aims at providing health and safety of workers by eliminating work-related injuries and disasters, and loss of assets and life by proactive efforts. It also aims at ensuring provision of humane and safe work environment for employees and elimination of abuse of children at work. It pledges for sustainable enterprise development through creation of green jobs and thereby improves safety, health, and work environment. Another area of national occupational health policy is continuous improvement of community education and creation of awareness about occupational safety.

National Programme for Control and Treatment of Occupational Diseases

The Ministry of Health and Family Welfare, Government of India, launched "National Programme for Control and Treatment of Occupational Diseases" in 1998–99. The National Institute of Occupational Health, Ahmedabad, functions as the nodal center for the same. Under the National Programme for Control and Treatment of Occupational Diseases, focus is on the following areas:

- Prevention, control, and treatment of silicosis and silicotuberculosis in agate industry
- Occupational health problems of tobacco workers and their prevention
- Identification of hazardous processes and chemicals, database generation, documentation, and information dissemination of the same
- Capacity building to promote research, education, and training at the National Institute of Occupational Health
- Health risk assessment and development of intervention program in cottage industries with a high risk of silicosis

After the Bhopal gas tragedy, the revised factory act has taken measures to ensure occupational health in factory workers by enforcing the following regulations. The owners of the factory with hazardous processes are expected to have an occupational health center with a qualified doctor.

- Prepare and communicate health and safety policy.
- Define the hazardous processes clearly.
- Inform the workers, inspectorate, and the public mandatorily.
- Prepare and practice disaster management programs.
- Conduct medical examinations of the employees and keep updated records with qualification and attendance of doctors specified.
- Keep record of equipment and drugs prescribed.

Training and Capacity Building and Research

The Central Labour Institute and the National Institute of Occupational Health provide training to occupational health professionals. The demand and supply gap is wide and needs further work in this area. The six institutes that function in different cities engage in surveys and research activities in collaboration with international agencies and NGOs.

Challenges in Occupational Health in India

There is a huge unorganized sector that does not come under the legal provisions of occupational health. There is poor awareness on the health hazards by the largely less educated employees and availability of only few trained occupational health manpower. Because of all these factors, implementation of risk assessment and surveillance and installation of preventive strategies in hazardous processes/industry suffer greatly. All the stakeholders

including employees and employers need to be educated about the benefits of preventive strategies.

CRITICAL THINKING EXERCISE

1. You are a nurse employed in a hospital attached to lignite mining factory. Most of the employees are educated up to secondary school level. You have observed that many of them have the habit of smoking and they hardly wear a mask. You have observed one of the employee, Mr. K, with history of childhood asthma present with worsening of cough and respiratory distress recently. As an industrial nurse, what are the common health problems you expect in your mining industry employees. What are the parameters you are most likely to monitor? What are your recommendations to the top management in realtion to maintaining health of thevworkers? How will you tackle the problem of noncompliance? Plan the nursing care of Mr. K applying nursing process.

REFERENCES

Books

Ministry of Labour, Government of India. (2017). Annual report 2017–2018. Retrieved on 7/13/2018 at: https://labour.gov.in/sites/default/files/ANNUAL_REPORT_2017-18-ENGLISH.pdf.

National Institute of Deafness and Other Communication Disorder. (2017). Noise induced hearing loss. Retrieved on 1/2/2018 at: https://www.nidcd.nih.gov/health/noise-induced-hearing-loss.

Nenonen, N. & Saarela, K. L. (2014). Global estimates of occupational accidents and work-related illnesses. Finland: Tampere University of Technology, pp. 1–25.

Occupational health and services—Indian scenario. Retrieved on 12/30/2017 at: https://amrc.org.hk sites/default/files/Occupational%20status%20report%20-%20India.pdf.

Whitaker, S. & Baranski, B. (2001). The role of the occupational health nurse in workplace health management. Copenhagen: WHO Regional Office for the Eastern Mediterranean, pp. 1–168.

World Health Organization. (2001). Occupational health: A manual for primary health care workers. Cairo: WHO Eastern Mediterranean Office. Retrieved on 1/2/2018 at: http://www.who.int/occupational_health/publications/emhealthcarework/en/.

Journal and Electronic Documents

Bhatia, R. & Sharma, V. K. (2017). Occupational dermatoses: An Asian perspective. Indian Journal of Dermatology, Venereology and Leprology, 83, 525–535.

Bluementhal, I. (2001). Carbon monoxide poisoning. Journal of Royal Society of Medicine, 94, 270–272.

Burton, J. (2010). WHO Healthy workplace framework: Background and supporting literature and practices. Retrieved on 1/12/2018 at: http://www.who.int/occupational_health/healthy_workplace_framework.pdf.

Cullinan, P., Munoz, X., Agius, R., et al. (2017). Occupational lung diseases. Lancet Respiratory Medicine, 5(5), 445–455. Retrieved on 6/1/2018 at: http://dx.doi.org/10.1016/S2213-2260(16)30424-30426.

Dahl, A. A. & Stoppler, M. C. (2017). Corneal flush burn. E-Medicine Health. Retrieved on 7/12/2018 at: https://www.emedicinehealth.com/corneal_flash_burns/article_em.htm.

de Castro, A. B. (2004). Handle with care: The American Nurses Association's campaign to address work-related musculoskeletal disorders. Online Journal of Issues in Nursing, 9(3), 1–14.

Foulds, I. (2005). Occupational dermatitis. Journal of Community Nursing, 19(2), 27–29.

Gannon, P. F. G., Bright P., Campbell, M., Hickey, S. P. O., & Burge, P. S. (1995). Occupational asthma due to glutaraldehyde and formaldehyde in endoscopy and X-ray department. Thorax, 50, 156–159.

Ghosh, T., Das, B., & Gangopadhyay, S. (2011). A comparative ergonomic study of work-related upper extremity musculoskeletal disorder among the unskilled and skilled surgical blacksmiths in West Bengal, India. Indian Journal of Occupational and Environmental Medicine, 15(3), 127–132.

Gowda, G., Vijayeendra, A. M., Sarkar, N., et al. (2014). A study on occupational asthma among workers in silk filatures in South India. Indian Journal of Occupational and Environmental Medicine, 18(2), 64–67.

Guidotti, T. L. (2007). Evaluating causality for occupational cancers: The example of firefighters. Occupational Medicine, 57, 466–471.

ICMR Bulletin. (1999) Silicosis—An uncommonly diagnosed common occupational disease. 29(9), 1–7.

Ivanov, I. (2013). WHO global plan of action on workers' health. 2008–2017. Geneva: World Health Organization, pp. 1–2.

Jadhav, A. V. & Roy, N. (2012). Asbestosis: Past voices from the Mumbai factory floor. Indian Journal of Occupational and Environment Medicine, 16(3), 131–136.

Kuijer, P. P. F. M., Verbeek, J. H., Visser, B., et al. (2014). An evidence-based multidisciplinary practice guideline to reduce the workload due to lifting for preventing work-related low back pain. Annals of Occupational and Environmental Medicine, 26(16), 1–9. Retrieved on 1/12/2017 at: http://www.aoemj.com/content/26/1/16.

Mahadevan, H. (2009). Employee participation in achieving industrial safety and health—Vision 2020. Indian Journal of Occupational and Environment Medicine, 3(2), 57–59.

Mapp, C. E., Boschetto, P., Maestrelli, P., & Fabbri, L. M. (2005). Occupational asthma. American Journal of Respiratory and Critical Care Medicine, 172, 280–305.

National Policy on Safety, Health and Environment at Work Place. Ministry of Labour and Employment, Government of India, pp. 1–11. Retrieved on 12/30/2017 at: http://labour.gov.in/sites/default/files/SafetyHealthandEnvironmentatWorkPlace.pdf.

National Programme for Control & Treatment of Occupational Diseases (2014). Retrieved on 06/30/2018 at: http://www.nihfw.org/nationalhealthprogramme/nationalprogrammeforcontrol.htm.

National Occupational Safety and Health Profile. (2015). Retrieved on 7/24/2018 at http://www.dgfasli.nic.in/Nat-OSH-India-Draft.pdf

Nelson, A., Baptiste, A. (2004). Evidence-Based Practices for Safe Patient Handling and Movement. Online Journal of Issues in Nursing, 9(3). Retrieved on 6/30/2018 at www.nursingworld.org/ojin/topic25/tpc25_3.htm.

Nicholson, P. J., Cullinan, P., Taylor, A. J. N., Burge, P. S., & Boyle, C. (2005). Evidence based guidelines for the prevention and identification and management of occupational asthma. Journal of Occupational Environment Medicine, 62, 290–299.

Priolcar, X. (2013). Occupational health nursing—Growing influence at work place in India. Indian Journal of Occupational and Environmental Medicine, 17(1), 1.

Rastogi, S. K., Kesavachandran, C., Mahdi, F., & Pandey, A. (2007). Occupational cancers in leather tanning industries: A short review. Indian Journal of Occupational and Environment Medicine, 11(1), 3–5.

Rees, D. & Murray, J. (2007). Silica, silicosis, and tuberculosis. The International Journal of Tuberculosis and Lung Disease, 11(5), 474–484.

Reid, P. T. & Reid, P. A. (2013). Occupational lung diseases. Journal of the Royal College of Physicians of Edinburgh, 43, 44. Retrieved on 1/8/2018 at: http://dx.doi.org/10.4997/JRCPE.2013.111.

Roy, G. D. M., Lortie, M., & Roy, R. (1988). Examination of biomechanical principles in a patient handling task. International Journal of Industrial Ergonomics, 3, 29–40.

Sharma, N., Kundtu, D., Dhakeda, S., & Das, A. (2016). Silicosis and silicotuberculosis in India. Bulletin of the World Health Organization. Online version retrieved on 12/2/2017 at: http://www.who.int/bulletin/online_first/BLT.15.163550.pdf.

Subrathy, A. H. & Korumtollee, F. (2005). Occupational overuse syndrome among keyboard users in Mauritius. Indian Journal of Occupational and Environmental Medicine, 9(2), 71–75.

Veys, C. (1996). Occupational cancers. BMJ: British Medical Journal, 313(7057), 615–619.
Wiwanitkit, V. (2014). Benzene, cytochrome, carcinogenesis: A topic in preventive toxicology. Indian Journal of Occupational and Environment Medicine, 18(2), 97–99.
World Health Organization. (1994). Declaration on occupational health for all. Retrieved on 1/2/2018 at: http://www.who.int/occupational_health/en/oehdeclaration94e.pdf?ua=1.
World Health Organization. (1999). Hazard prevention and control in the work environment. Airborne dust. WHO/SDE/OEH/99.14, pp. 1–96. Retrieved on 1/2/2018 at: http://www.who.int/occupational_health/publications/en/oehairbornedust3.pdf?ua=1.

Resources

Alberta Occupational Health and Safety, http://work.alberta.ca/occupational–health-safety
All India Institute of Hygiene and Public Health, http://www.irc.nl/page/6624
Canadian Occupational Safety, http://www.cos-mag.com
CDC Workplace Health Resource Center, https://www.cdc.gov/workplacehealthpromotion/initiatives/resource-center/index.html
Centre for Occupational and Environmental Health, http://www.coeh.delhigovt.nic.in
Directorate General, Factory Advice Service and Labour Institutes, http://www.dgfasli.nic.in
Indian Association of Occupational Health (IAOH), http://www.iaohindia.com
Indian Institute of Toxicology Research, http://www.iitrindia.org
Institute for Work and Health: Resources for Students, http://www.iwh.on.ca/iwh-resources for students
National Institute of Miners' Health, http://www.nimh.gov.in
National Institute of Occupational Health, http://www.nioh.org
Occupational health and services—Indian scenario. Retrieved on 12/30/2017 at: https://amrc.org.hk sites/default/files/Occupational%20status%20report%20-%20India.pdf.
Occupational Health and Safety Magazine, http://work.alberta.ca./occupational-health-safety/ohs.magazine.html
Occupational Safety and Health Administration, http://www.osha.gov
Society for Participatory Research in Asia, http://www.pria.org
The International Commission on Occupational Health, http://www.icohweb.org
The National Institute for Occupational Safety and Health, http://www.cdc.gov/niosh

Appendix A
Diagnostic Studies and Interpretation

Test Value Studied

Reference Ranges—Hematology
Reference Ranges—Serum, Plasma and Whole Blood Chemistries
Reference Ranges—Immunodiagnostic Tests
Reference Ranges—Urine Chemistry
Reference Ranges—Cerebrospinal Fluid (CSF)

Selected Abbreviations Used in Reference Ranges

Conventional Units

kg = kilogram
gm = gram
mg = milligram
µg = microgram
µµg = micromicrogram
ng = nanogram
pg = picogram
dL = 100 milliliters
mL = milliliter
gm = gram
mm^3 = cubic millimeter
fL = femtoliter
mM = millimole
nM = nanomole
mOsm = milliosmole
mm = millimeter
µm = micron or micrometer
mm Hg = millimeters of mercury
U = unit
mU = milliunit
µU = microunit
mEq = milliequivalent
IU = International Unit
mIU = milliInternational Unit

SI Units

g = gram
L = liter
d = day
h = hour
mol = mole
mmol = millimole
µmol = micromole
nmol = nanomole
pmol = picomole

TABLE A-1 Reference Ranges—Hematology[a]

Test	Reference Range		Clinical Significance
	Conventional Units	SI Units	
Bleeding time	3–10 min Ivy method	3–10 min	Prolonged in thrombocytopenia, defective platelet function, and aspirin therapy
Factor V assay (labile factor)	50%–150%		Decreased in liver disease, factor V inhibitors, myeloproliferative disorders, DIC, and fibrinolysis
Factor VIII assay (antihemophiliac factor)	55%–145%	55–145 AU	Increased in late normal pregnancy, thromboembolic conditions, liver disease, postoperative period, and rebound period after sudden cessation of a Coumadin-type drug. Decreased in hemophilia A, immunologic reactions, postpartum, von Willebrand disease, DIC, fibrinolysis, and myeloproliferative disorders
Factor IX assay (Christmas factor)	60%–140%	60–140 AU	Decreased in uncompensated cirrhosis, liver disease, nephrotic syndrome, various anticoagulant drugs, DIC, and vitamin K deficiency
Factor X	45%–155%		Decreased in liver disease, oral anticoagulant drugs, amyloidosis, DIC, and vitamin deficiency
Fibrinogen	200–400 mg/dL	2–4 g/dL	Increased in pregnancy, infections, inflammation, acute MI, nephritic syndrome, cancers, and stroke Decreased in liver disease, DIC, cancer, primary fibrinolysis, and hereditary and congenital hypofibrinogenemia
Fibrin degradation products	<10 µg/mL	<10 mg/mL	Used to establish diagnosis of DIC and other thromboembolic disorders
Fibrinolysis (whole blood clot lysis time)	No lysis in 24 hr		Increased activity associated with hemorrhage and circulatory collapse, surgery, long-term DIC, liver disease, pregnancy complications, and other conditions

(*Continued*)

TABLE A-1 (*Continued*)

Test	Reference Range: Conventional Units	Reference Range: SI Units	Clinical Significance
Partial thromboplastin time (aPTT)	Lower limit of normal: 21–35 sec		Prolonged in deficiency of fibrinogen, factors II, V, VIII, IX, X, XI, and XII, in heparin therapy, DIC, liver disease, and other conditions
Prothrombin (PT)	Lower limit of normal: 11 sec Lower limit of normal: 13 sec		Impaired in deficiency of factors II, V, VIII, IX, and X, DIC, liver disease, and other conditions
INR	0.8–1.2		Prolonged by deficiency of factors I, II, V, VII, and X, fat malabsorption, severe liver disease, warfarin (Coumadin) anticoagulant therapy, and other conditions
Erythrocyte count	Males: 4,600,000–6,200,000/mm^3	4.6–6.2 × 10^{12}/L	Increased in severe diarrhea and dehydration, polycythemia, acute poisoning, pulmonary fibrosis
	Females: 4,200,000–5,400,000/mm^3	4.2–5.4 × 10^{12}/L	Decreased in all anemias, in leukemia, and after hemorrhage when blood volume has been restored
Erythrocyte Indices			
Mean corpuscular volume (MCV)	82–98 mcm^3	82–98 fL	Increased in macrocytic anemias; decreased in microcytic anemia
Mean corpuscular hemoglobin (MCH)	26–34 pg/cell	0.40 to 0.53 fmol/cell	Increased in macrocytic anemias; decreased in microcytic anemia
Mean corpuscular hemoglobin concentration (MCHC)	32–36 g/dL	4.9 to 5.5 mmol/L	Decreased in severe hypochromic anemia
Reticulocytes	0.5%–1.5% of RBCs	Number fraction: 0.005–0.015	Increased with any condition stimulating increase in bone marrow activity (e.g., infection, blood loss [acute and chronically following iron therapy in iron deficiency anemia], polycythemia vera) Decreased with any condition depressing bone marrow activity, acute leukemia, late stage of severe anemias
ESR	Males under 50 yrs: 0–15 mm/hr	<15 mm/hr	Increased in tissue destruction, whether inflammatory or degenerative; during menstruation and pregnancy; in acute febrile diseases, and other conditions
	Males over 50 yrs: 0–20 mm/hr	<20 mm/hr	
	Females under 50 yrs: 0–20 mm/hr	<25 mm/hr	
	Females over 50 yrs: 0–30 mm/hr	<30 mm/hr	
Hematocrit	Males: 42%–52% Females: 36%–48%	Volume fraction: 0.42–0.52 Volume fraction: 0.36–0.48	Decreased in anemias, including anemia of pregnancy, acute blood loss, and other conditions Increased in erythrocytosis of any cause, and in dehydration or hemoconcentration associated with shock
Hemoglobin	Males: 14.0–17.4 g/dL Females: 12.0–16 g/dL	140–174 g/L 120–160 g/L	Decreased in anemias, pregnancy, hemorrhage, with excessive fluid intake, and other conditions Increased in polycythemia, chronic obstructive pulmonary disease, failure of oxygenation because of congestive heart failure, and normally in people living at high altitudes
Leukocyte alkaline phosphatase	40–100 units		Increased in polycythemia vera, myelofibrosis, various cancers, and other conditions Decreased in chronic myeloid leukemia, paroxysmal nocturnal hemoglobinuria, idiopathic thrombocytopenic purpura, hereditary hypophosphatasia, progressive muscular dystrophy, marked eosinophilia, nephritic syndrome, and siderocytic anemia
Leukocyte count	Total: 4,500–11,000/mm^3	4.5 × 10^9/L	Neutrophils increase with acute infections, trauma or surgery, leukemia, malignant disease, necrosis; decreased with viral infections, bone marrow suppression, primary bone marrow disease
Neutrophils	45%–73%	Number fraction: 0.45–0.73	
Eosinophils	0%–4%	Number fraction: 0.00–0.04	Eosinophils increased in allergy, parasitic disease, collagen disease, subacute infections; decreased with stress, use of some medications (ACTH, epinephrine, thyroxine)
Basophils	0%–1%	Number fraction: 0.00–0.01	Basophils increased with acute leukemia and following surgery or trauma; decreased with allergic reactions, stress, allergy, parasitic disease, use of corticosteroids
Lymphocytes	20%–40%	Number fraction: 0.2–0.4	Lymphocytes increased with infectious mononucleosis, viral and some bacterial infections, hepatitis; decreased with aplastic anemia, SLE, immune deficiency including AIDS

(*Continued*)

(*Continued*)

Test	Reference Range		Clinical Significance
	Conventional Units	SI Units	
Monocytes	2%–8%	Number fraction: 0.02–0.08	Monocytes increased with viral infections, parasitic disease, collagen and hemolytic disorders; decreased with use of corticosteroids, RA, HIV infection
Platelet count	140,000–400,000/mm^3	0.14–0.4 × 10^{12}/L	Increased in cancer, myeloproliferative disease, RA, and postoperatively Decreased in thrombocytopenic purpura, acute leukemia, aplastic anemia, and during cancer chemotherapy

[a]Laboratory values and reference ranges may vary in different laboratories. AIDS, acquired immune deficiency syndrome; DIC, disseminated intravascular coagulation; INR, international normalized ratio; ESR, erythrocyte sedimentation rate; HIV, human immune deficiency virus; MI, myocardial infarction; RA, rheumatoid arthritis; RBC, red blood cell.

TABLE A-2 Reference Ranges—Serum, Plasma, and Whole Blood Chemistries

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
Acetoacetate	0.2–1.0 mg/dL	19.6–98 mcmol/L	Diabetic ketoacidosis, and fasting	
Acetone	0.3–2.0 mg/dL	51.6–3440/mcmol/L	Diabetic ketoacidosis, toxemia of pregnancy, and carbohydrate-free diet, high-fat diet	
Acid, total phosphatase	Males: 2–12 UL Females: 0.3–9.2 UL	Males: 2–12 UL Females: 0.3–9.2 UL	Carcinoma of prostate, advanced Paget disease, hyperparathyroidism, and Gaucher disease	
Acid, phosphatase, prostatic—RIA	<2.5 ng/mL	<2.5 ug/L	Carcinoma of prostate	
Alkaline phosphatase	Adults: 25–100 UL	0.43–1.70 mkat/L	Conditions reflecting increased osteoblastic activity of bone, including many liver diseases, bone diseases, and other conditions	
Adrenocorticotropic hormone (ACTH) (plasma)—RIA[a]	<120 pg/mL	<120 ng/L	Pituitary-dependent Cushing syndrome, ectopic ACTH syndrome, and primary adrenal atrophy	Adrenocortical tumor, adrenal insufficiency secondary to hypopituitarism
Aldolase	3–8 Sibley–Lehninger U/dL at 37°C	22–59 mU/L at 37°C	Hepatic necrosis, granulocytic leukemia, myocardial infarction, and skeletal muscle disease	
Aldosterone (plasma)—RIA	Supine: 3–16 ng/dL Upright: 7–30 ng/dL Adrenal vein: 200–800 ng/dL	0.08–0.30 nmol/L 0.14–0.90 nmol/L 5.54–22.16 nmol/L	Primary and secondary aldosteronism	Addison disease
Alpha-1-antitrypsin	110–140 mg/dL	1.1–1.4 g/L		Certain forms of chronic lung and liver disease in young adults
Alpha-hydroxybutyric dehydrogenase	<140 U/L	<140 U/L	Myocardial infarction, granulocytic leukemia, hemolytic anemias, and muscular dystrophy	
Ammonia (plasma)	15–45 mcg/dL (varies with method)	11–32/mcmol/L	Severe liver disease, and hepatic decompensation	
Amylase	25–125 U/L Older adults: 24–151 U/L	0.4–2.1 μkt/L 0.4–2.5 μkt/L	Acute pancreatitis, mumps, duodenal ulcer, carcinoma of head of pancreas, prolonged elevation with pseudocyst of pancreas, and medications that constrict pancreatic duct sphincters: morphine, codeine, cholinergics	Chronic pancreatitis, pancreatic fibrosis and atrophy, cirrhosis of liver, and pregnancy (2nd and 3rd trimesters)

(*Continued*)

TABLE A-2 (*Continued*)

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
Arsenic	<70 mcg/dL; poisoning: 100–150 mcg/dL	<0.93–2.6 mcmol/L; poisoning: 133–6.65 mcmol/L	Intentional or unintentional poisoning, and excessive occupational exposure	
Ascorbic acid (vitamin C)	0.4–1.5 mg/dL	23–85 mcmol/L	Large doses of ascorbic acid as a prophylactic against the common cold	
ALT (alanine aminotransferase), formerly SGPT	Males: 10–40 U/mL Females: 8–35 U/mL	Males: 0.17–0.68 mckat/L Females: 0.14–0.60 mckat/L	Same conditions as AST (SGOT), but increase is more marked in liver disease than AST (SGOT)	
AST (aspartate aminotransferase), formerly SGOT	Males: 10–40 U/L Females: 15–30 U/L	Males: 0.34–0.68 mckat/L Females: 0.25–0.51 mckat/L	Myocardial infarction, skeletal muscle disease, and liver disease	
Bilirubin	Total: 0.3–1.0 mg/dL Direct: <0.5 mg/dL Indirect: 0.1–1 mg/dL	5–17 mcmol/L <6.8 µmol/L 1.7–17.1 µmol/L	Hemolytic anemia (indirect), biliary obstruction and disease, hepatocellular damage (hepatitis), and pernicious anemia	
Brain (B-type) natriuretic peptide (BNP)	<100 pg/mL	100 ng/L	Heart failure, cardiac volume overload	
Calcitonin	Basal: <8.4 pg/mL Stimulation test Males: <190 pg/mL Females: <35 pg/mL	8.4 ng/L <190 ng/L <35 ng/L	Medullary carcinoma of the thyroid, some nonthyroid tumors, Zollinger–Ellison syndrome	
Calcium	8.8–10.2 mg/dL	2.052–2.6 mmol/L	Tumor or hyperplasia of parathyroid, hypervitaminosis D, multiple myeloma, nephritis with uremia, malignant tumors, sarcoidosis, hypoparathyroidism, skeletal immobilization, excess calcium intake: milk alkali syndrome	Hyperthyroidism, diarrhea, celiac disease, vitamin D deficiency, acute pancreatitis, nephrosis, parathyroidectomy
CO_2, venous	Adults: 24–32 mEq/L Infants: 22–24 mEq/L	24–32 mmol/L 22–24 mmol/L	Tetany, respiratory disease, intestinal obstruction, vomiting, and pheochromocytoma	Acidosis, nephritis, eclampsia, diarrhea, and anesthesia
Catecholamines (plasma)—RIA	Epinephrine: <100 pg/mL Norepinephrine: <400 pg/mL Dopamine: <143 pg/mL	<540 pmol/L <2360 pmol/L <935 pmol/L		
Ceruloplasmin	25–63 mg/dL	250–630 mg/L		Wilson disease (hepatolenticular degeneration)
Chloride	96–106 mEq/L	96–106 mmol/L	Nephrosis, nephritis, urinary obstruction, cardiac decompensation, and anemia	Diabetes, diarrhea, vomiting, pneumonia, heavy metal poisoning, Cushing syndrome, intestinal obstruction, and other febrile conditions
Cholesterol	Males: <205 mg/dL Females: <190 mg/dL	<5.3 mmol/L <4.9 mmol/L	Lipemia, obstructive jaundice, diabetes, and hyperthyroidism	Pernicious anemia, hemolytic anemia, hypothyroidism, severe infection, and terminal states of debilitating disease
Cholinesterase	Serum: 0.6–1.6 delta pH Red cells: 0.6–1 delta pH	0.6–1.6 U 0.6–1 U	Nephrosis, and exercise	Nerve gas exposure (greater effect on red cell activity), and insecticide poisoning
Complement, C_3	75–175 mg/dL	0.75–1.75 g/L	Some inflammatory diseases, acute myocardial infarction, cancer	Acute glomerulonephritis, and disseminated lupus erythematosus with renal involvement

(*Continued*)

(*Continued*)

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
Complement, C_4	14–40 mg/dL	0.15–0.45 g/L	Some inflammatory diseases, acute myocardial infarction, and cancer	Often decreased in immunologic disease, especially with active systemic lupus erythematosus, and hereditary angioneurotic edema
Complement, total (hemolytic)	90%–94% complement	30–60 U/mL	Some inflammatory diseases	Acute glomerulonephritis, meningitis, and subacute bacterial endocarditis
Copper	70–150 mcg/dL	11–24 mcmol/L	Cirrhosis of liver, and pregnancy	Wilson disease
Cortisol-RIA	8 AM: 5–23/mcg/dL 4 PM: 3–16 mcg/dL	138–635 nmol/L 80–330 nmol/L	Stress: infectious disease, surgery, burns, etc., pregnancy, Cushing syndrome, pancreatitis, and eclampsia	Addison disease, and anterior pituitary hypofunction
C-peptide reactivity	0.78–1.89 ng/mL	0.26–.63 mmol/L	Insulinoma	Diabetes
Creatine		15.3–61 mcmol/L	Pregnancy, skeletal muscle necrosis or atrophy, starvation, and hyperthyroidism	
Creatine phosphokinase (CPK)	Males: 50–325 mU/mL Females: 50–250 mU/mL	50–325 U/L 50–250 U/L	Myocardial infarction, skeletal muscle diseases, intramuscular injections, Crush syndrome, hypothyroidism, alcohol withdrawal delirium, alcoholic myopathy, cerebrovascular disease	
Creatine kinase (CK) isoenzymes	MM band present (skeletal muscle)-MB band absent (heart muscle)		MB band increased in myocardial infarction, ischemia	
Creatinine	Males: 0.4 to 1.0 mg/dL Females: 0.6–1.2 mg/dL	36 to 90 mmol/L 71–106 mmol/L	Nephritis, chronic renal disease	
Creatinine clearance	Males: 85–125 mL/min Females: 75–115 mL/min	1.42–2.08 mL/s 1.25–1.92 mL/s		Kidney diseases
Cryoglobulins, qualitative	Negative		Multiple myeloma, chronic lymphocytic leukemia, lymphosarcoma, systemic lupus erythematosus, rheumatoid arthritis, infective subacute endocarditis, some malignancies, and scleroderma	
11-Deoxycortisol	1 mcg/dL	<0.029 mcmol/L	Hypertensive form of virilizing adrenal hyperplasia due to an 11-β-hydroxylase defect	
Dibucaine inhibition	Normal: 79%–84%	0.79–0.84%		Important in detecting carriers of abnormal cholinesterase activity who are at risk for a number of conditions
Dihydrotestosterone	Males: 50–210 ng/dL Females: none detectable	1.72–7.22 nmol/L		Testicular feminization syndrome
Estradiol—RIA	Females: Follicular: 10–90 pg/mL Midcycle: 100–500 pg/mL Luteal: 50–240 pg/mL Follicular phase: 2–20 ng/dL Midcycle: 12–40 ng/dL Luteal phase: 10–30 ng/dL Postmenopausal: 1–5 ng/dL Males: 0.5–5 ng/dL	 37–370 pmol/L 367–1835 pmol/L 184–881 pmol/L	Pregnancy, or ovarian tumor	Ovarian failure
Estriol—RIA	Nonpregnant females: <0.5 ng/mL Pregnant females: 1st trimester: up to 1 ng/mL 2nd trimester: 0.8–7 ng/mL 3rd trimester: 5–25 ng/mL	<1.75 nmol/L Up to 3.5 nmol/L 2.8–24.3 nmol/L 17.4–86.8 nmol/L	Pregnancy	Ovarian failure

(*Continued*)

TABLE A-2 (*Continued*)

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
Estrogens, total—RIA	Females: cycle days: Day 1–10: 61–394 pg/mL Day 11–20: 122–437 pg/mL Day 21–30: 156–350 pg/mL Males: 20–80 pg/mL	 61–394 ng/L 122–437 ng/L 156–350 ng/L 20–80 ng/L	Pregnancy, measured on a daily basis, can be used to evaluate response of hypogonadotrophic, hypoestrogenic women to human menopausal or pituitary gonadotropin	Fetal distress, ovarian failure
Estrone—RIA	Females: Day 1–10: 4.3–18 ng/dL Day 11–20: 7.5–19.6 ng/dL Day 21–30: 13–20 ng/dL Males: 2.5–7.5 ng/dL	 15.9–66.6 pmol/L 27.8–72.5 pmol/L 48.1–74 pmol/L 9.3–27.8 pmol/L	Pregnancy	Ovarian failure
Ferritin—RIA	Males: 18–270 ng/mL Females: 18–160 ng/mL	18–270 µg/L 18–160 µg/L	Nephritis, and hemochromatosis Certain neoplastic diseases, acute myeloid leukemia, and multiple myeloma	Iron deficiency
Folic acid—RIA	3–13 ng/mL	6.8–29.5 nmol/L		Megaloblastic anemias of infancy and pregnancy, inadequate diet, liver disease, malabsorption syndrome, and severe hemolytic anemia
Follicle-stimulating hormone (FSH)—RIA	Males: 1.24–7.8 mIU/mL Females: Follicular phase: 1.68–15 mIU/mL Peak of middle cycle: 21.9–56.6 mIU/mL Luteinic phase: 0.61–16.3 mIU/mL Menopausal females: 14.2–52.3 mIU/mL	1.24–7.8 IU/L 1.68–15 IU/L 21.9–56.6 IU/L 0.61–16.3 IU/L 14.2–52.3 IU/L	Menopause and primary ovarian failure	Pituitary failure
Galactose	<5 mg/dL	<0.28 mmol/L		Galactosemia
Gamma glutamyl transpeptidase	Males: 20–30 U/L Females: 1–24 U/L	0.03–0.5 mckat/L 0.02–0.4 mckat/L	Hepatobiliary disease, drug toxicity, myocardial infarction, renal infarction, and Zollinger–Ellison syndrome	
Gastrin—RIA	Fasting: 50–155 pg/mL Postprandial: 80–170 pg/mL	50–155 ng/L 80–170 ng/L	Duodenal ulcer, and pernicious anemia	
Glucose	Fasting: 60–100 mg/dL	≤5.6 mmol/L	Diabetes, nephritis, hypothyroidism, early hyperpituitarism, cerebral lesions, infections, pregnancy, and uremia	Hyperinsulinism, hyperthyroidism, late hyperpituitarism, Addison disease, and extensive hepatic damage
Glucose tolerance (oral)	Features of a normal response 1. Normal fasting between 60–110 mg/dL 2. No sugar in urine 3. Upper limits of normal Fasting = 125 mg/dL 1 hour = 190 mg/dL 2 hours = 140 mg/dL 3 hours = 125 mg/dL	3.3–6.05 mmol/L 6.88 mmol/L 10.45 mmol/L 7.70 mmol/L 6.88 mmol/L	Two-hour value >200 mg/dL (11.1 mmol/L) is diagnostic for diabetes	Decreased 2- and 3-hour values may occur with hypoglycemia in diabetes
Glucose-6-phosphate dehydrogenase (red cells)	Screening: Decolorization in 20–100 min Quantitative: 1.86–2.5 IU/mL RBC	 1860–2500 U/L		Drug-induced hemolytic anemia
Glycoprotein (alpha-1-acid)	50–120 mg/dL	0.5–1.2 g/L	Neoplasm, tuberculosis, diabetes complicated by degenerative vascular disease, pregnancy, rheumatoid arthritis, rheumatic fever, infectious liver disease, and systemic lupus erythematosus	

(*Continued*)

(*Continued*)

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
Growth hormone—RIA	Males: 0–4 ng/mL Females: 0–10 ng/mL	0.4 mcg/L 0–18 mcg/L	Acromegaly, pregnancy, and estrogen therapy	Hypopituitarism
Haptoglobin	30–200 mg/dL	0.3–2.0 g/L	Chronic infections, and various inflammatory conditions	Hemolytic anemia, and hemolytic blood transfusion reaction
Hemoglobin (plasma)	Males: 12.4–17.4 g/dL Females: 11.7–16 g/dL	112–174 g/L 117–160 g/L	Transfusion reactions, paroxysmal nocturnal hemoglobinuria, and intravascular hemolysis	Anemia, pregnancy, and chronic renal disease
Glycohemoglobin (GHB, hemoglobin A_{1c}, hemoglobin A1)	Patients without diabetes and patients with diabetes with good glycemic control: 4.4%–6.4%		Suboptimal glucose control	
Hexosaminidase, total	Controls: 333–375 nM/mL/hr	333–375 mcmol/L/hr	Sandhoff disease	Tay–Sachs disease and heterozygotes
Hexosaminidase A	Controls: 55%–76% of total Heterozygotes: 26%–45% of total Tay–Sachs disease: 0%–4% of total Diabetes: 39%–59% of total	Fraction of total: 0.49–0.68 0.26–0.45 0–0.04 0.39–0.59		
High-density lipoprotein cholesterol (HDL cholesterol)	Males: 35–65 mg/dL Females: 35–80 mg/dL	0.91–1.68 mmol/L 0.91–2.07 mmol/L		HDL cholesterol is lower in patients with increased risk for coronary artery disease
17 Hydroxy-progesterone—RIA	Males: 0.5–2.0 ng/mL Females: 0.2–3.0 ng/mL Children: <1.0 ng/mL	1.5–6.0 nmol/L 0.6–9.0 nmol/L <3.0 nmol/L	Congenital adrenal hyperplasia, pregnancy, some cases of adrenal or ovarian adenomas	
Immunoglobulin A	Adults: 80–400 mg/dL	0.8–4.0 g/L	Gamma A myeloma, Wiskott–Aldrich syndrome, autoimmune disease, and hepatic cirrhosis	Ataxia telangiectasis, agammaglobulinemia, hypogammaglobulinemia, transient dysgammaglobulinemia, protein-losing enteropathies
Immunoglobulin D	0.5–12.0 mg/dL	5–120 mg/L	IgD multiple myeloma, some patients with chronic infectious diseases	
Immunoglobulin E	<1.0 mg/mL	<10 mg/L	Allergic reactions, parasitic infections	
Immunoglobulin G	Adults: 600–1800 mg/dL	6–18 g/L	IgG multiple myeloma, following hyperimmunization, autoimmune disease states, chronic infections	Congenital and acquired hypogammaglobulinemia, IgA multiple myelomas, Waldenström (IgM) macroglobulinemia, some malabsorption syndromes, and extensive protein loss
Immunoglobulin M	Adults: 55–250 mg/dL	0.55–2.5 g/L	Waldenström macroglobulinemia, parasitic infections, and hepatitis	Agammaglobulinemias, multiple myeloma, and chronic lymphocytic leukemia
Insulin—RIA	0–35 mcU/mL	144–243 pmol/L	Insulinoma, and acromegaly	Diabetes
Iron	50–150/mcg/dL	9–29 mcmol/L	Pernicious anemia, aplastic anemia, hemolytic anemia, hepatitis, and hemochromatosis	Iron deficiency anemia
Iron-binding capacity	IBC: 250–350 mcg/dL TIBC: 250–450 mcg/dL % Saturation: 10–50	45–63 mcmol/L 54–65 mcmol/L Fraction of total iron-binding capacity: 0.2–0.5	Iron deficiency anemia, acute and chronic blood loss, and hepatitis	Chronic infectious diseases, and cirrhosis
Isocitric dehydrogenase	50–180 U	0.83–3 U/L	Hepatitis, cirrhosis, obstructive jaundice, metastatic carcinoma of the liver, and megaloblastic anemia	

(*Continued*)

TABLE A-2 (*Continued*)

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
Lactic acid (whole blood)	Venous: 5–15 mg/dL Arterial: 3–11 mg/dL	0.5–1.7 mmol/L 0.36–1.25 mmol/L	Increased muscular activity, heart failure, hemorrhage, shock, lactic acidosis, some febrile infections, and severe liver disease	
Lactic dehydrogenase (LDH)	<61 mU/mL	90–176 U/L	Untreated pernicious anemia, myocardial infarction, pulmonary infarction, and liver disease	
[a]Lactic dehydrogenase isoenzymes	140–280 mU/mL	140–280 U/L	LDH-1 and LDH-2 are increased in myocardial infarction, megaloblastic anemia, and hemolytic anemia	
Total lactic dehydrogenase		Fraction of total LDH:		
LDH-1	17%–27%	0.17–0.27	LDH-4 and LDH-5 are increased in pulmonary infarction, congestive heart failure, and liver disease	
LDH-2	29%–39%	0.29–0.39		
LDH-3	19%–27%	0.19–0.27		
LDH-4	8%–16%	0.08–0.16		
LDH-5	6%–16%	0.06–0.16		
Lead (whole blood)	Up to 40 mcg/dL	Up to 2 mcmol/L	Lead poisoning	
Leucine aminopeptidase	75–200 U/mL	75–200 kilounits/L	Liver or biliary tract diseases pancreatic disease, metastatic carcinoma of liver and pancreas, biliary obstruction	
[b]Lipase	<140 U/mL	<140 U/L	Acute and chronic pancreatitis, biliary obstruction, cirrhosis, hepatitis, and peptic ulcer	
Lipids, total	400–800 mg/dL	4–8 g/L	Hypothyroidism, diabetes, nephrosis, glomerulonephritis, andhyperlipoproteinemias.	Hyperthyroidism
Low-density lipoprotein cholesterol (LDL cholesterol)	mg/dL desirable levels: <160 if no coronary artery disease (CAD) and <2 risk factors <130 if no CAD and two or more risk factors <100 if CAD present		LDL cholesterol is higher in patients with increased risk for coronary artery disease	
Luteinizing hormone—RIA	Males: 1.5–9.3 mU/mL Females:	1.5–9.3 U/L	Pituitary tumor, or ovarian failure	Pituitary failure
	Follicular phase: 1.9–12.5 mU/mL	1.9–12.5 U/L		
	Midcycle: 8.7–76.3 mU/mL	8.7–76.3 U/L		
Lysozyme (muramidase)	4.0–15.6 mcg/mL	0.28–1.10 mcmol/L	Certain types of leukemia (acute myeloid leukemia), inflammatory states and infections	Acute lymphocytic leukemia
Magnesium	1.8–2.6 mg/dL	0.74–1.07 mmol/L	Excess ingestion of magnesium-containing antacids	Chronic alcoholism, severe renal disease, and diarrhea
Mercury	<10 mcg/L	<50 mcmol/L	Mercury poisoning	
Myoglobin	No myoglobin	0 mcg/mL	Myocardial infarction, myocardial ischemia, rhabdomyolysis, and malignant hyperthermia	Rheumatoid arthritis, and myasthenia gravis
5′ Nucleotidase	3.2–11.6 IU/L	3.2–11.6 U/L	Hepatobiliary disease	
Osmolality	50–1200 mOsm/kg 300–900 mOsm/kg in 24 hr	275–300 mmol/L	Diabetes insipidus, osmotic diuresis	Inappropriate secretion of ADH, Addison disease
Parathyroid hormone	10–50 pg/mL	10–50 ng/L	Hyperparathyroidism, chronic renal disease	Hypoparathyroidism
Phenylalanine	1.2–3.5 mg/dL 1st week 0.7–3.5 mg/dL thereafter	0.07–0.21 mmol/L 0.04–0.21 mmol/L	Phenylketonuria	
Phosphohexose isomerase	20–90 IU/L	20–90 U/L	Malignancy, disease of heart, liver, and skeletal muscles	
Phospholipids	125–300 mg/dL	1.25–3 g/L	Diabetes, or nephritis	
Phosphorus, inorganic	2.7–4.5 mg/dL	0.87–1.45 mmol/L	Chronic nephritis, and hypoparathyroidism	

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(*Continued*)

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
Potassium	3.5–5 mEq/L	3.5–5 mmol/L	Renal disease, acidosis, cell lysis, tissue breakdown, or hemolysis	Hyperparathyroidism, vitamin D deficiency, GI losses, diuretic administration
Prealbumin	16–35 mg/dL	160–350 mg/L	Malnutrition, severe or chronic illness, and liver disease	
Progesterone—RIA	Follicular phase: up to 0.8 ng/mL Luteal phase: 10–20 ng/mL End of cycle: <1 ng/mL Pregnant: up to 50 ng/mL in 20th week	2.5 nmol/L 31.8–63.6 nmol/L <3 nmol/L Up to 160 nmol/L	Useful in evaluation of menstrual disorders and infertility and in the evaluation of placental function during pregnancies complicated by toxemia, diabetes, or threatened miscarriage	
Prolactin—RIA	4–30 ng/mL	4–30 mcg/L	Pregnancy, functional or structural disorders of the hypothalamus, pituitary stalk section, and pituitary tumors	
Prostate-specific antigen	Age under 60 <3.6 ng/mL Age over 60 <6.6 ng/mL		Prostatic cancer, benign prostatic hyperplasia, prostatitis	
Protein, total Albumin Globulin	6–8 g/dL 3.5–5.5 g/dL 1.7–3.3 g/dL	60–80 g/L 40–55 g/L 17–33 g/L	Hemoconcentration, shock, globulin fraction increased in multiple myeloma, chronic infection, liver disease	Malnutrition, hemorrhage, loss of plasma from burns, and proteinuria
Protein Electrophoresis		35–55 g/L		
Albumin	3.5–5.5 g/dL	40–55 g/L		
Alpha-1 globulin	0.1–0.3 g/dL	1–3 g/L		
Alpha-2 globulin	0.6–1 g/dL	6–10 g/L		
Beta globulin	0.5–1.0 g/dL	5–10 g/L		
Gamma globulin	0.6–1.3 g/dL	6–13 g/L		
Protoporphyrin erythrocyte (whole blood)	Males: 11–45 mcg/dL Females: 19–52 mcg/dL	0.20–0.80 mcmol/L 0.34–0.92 mcmol/L	Lead toxicity, erythropoietic porphyria	
Pyridoxine	5–30 ng/mL	20–1.21 nmol/L		A wide spectrum of clinical conditions, such as depression, peripheral neuropathy, anemia, and reactions to certain drug therapies
Pyruvic acid (whole blood)	0.3–0.9 mg/dL	34–102 mcmol/L	Diabetes, severe thiamine deficiency, acute phase of some infections, possibly secondary to increased glycogenolysis and glycolysis	
Renin (plasma)—RLA	Normal diet: Supine: 0.3–1.9 ng/mL/h Upright: 0.6–3.6 ng/mL/h Low salt diet Supine: 0.9–4.5 ng/mL/h Upright: 4.1–9.1 ng/mL/h	 0.08–0.52 ng/L/S 0.16–1.00 mcg/L/S 0.25–1.25 mcg/L/S 1.13–2.53 mcg/L/S	Renovascular hypertension, malignant hypertension, untreated Addison disease, primary salt-losing nephropathy, low-salt diet, diuretic therapy, and hemorrhage	Frank primary aldosteronism, increased salt intake, salt–retaining steroid therapy, antidiuretic hormone therapy, and blood transfusion
Sodium	135–145 mEq/L	135–145 mmol/L	Hemoconcentration, nephritis, and pyloric obstruction	Alkali deficit, Addison disease, myxedema
Sulfate (inorganic)	0.5–1.5 mg/dL	0.05–0.15 mmol/L	Nephritis, and nitrogen retention	
Testosterone—RIA	Females: 20–80 ng/dL Males: 240–1200 ng/dL	0.7–2.8 nmol/L 18.3–41.8 nmol/L	Females: Polycystic ovary, and virilizing tumors	Males: Orchidectomy for neoplastic disease of the prostate or breast, estrogen therapy, Klinefelter syndrome, hypopituitarism, hypogonadism, and hepatic cirrhosis
T_3 (triiodothyronine) uptake	24%–34%	Relative uptake fraction: 0.24–0.34	Hyperthyroidism, thyroxine-binding globulin (TBG) deficiency, and androgens and anabolic steroids	Hypothyroidism Pregnancy, TBG excess, estrogens and antiovulatory drugs
T_3 total circulating—RIA	260–480 pg/dL	4.0–7.4 pmol/L	Pregnancy, and hyperthyroidism	Hypothyroidism

(*Continued*)

TABLE A-2 (*Continued*)

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
T_4 (thyroxine)—RIA	5.4–11.5 mcg/dL	57–148 nmol/L	Hyperthyroidism, thyroiditis, elevated thyroxine-binding proteins caused by oral contraceptives, and pregnancy	Primary and pituitary hypothyroidism, idiopathic involvement, cases of diminished thyroxine-binding proteins caused by androgenic and anabolic steroids, hypoproteinemia, and nephrotic syndrome
T_4, free	0.7–2 ng/dL	10–26 pmol/L	Euthyroid patients with normal free thyroxine levels may have abnormal T3 and T4 levels caused by drug preparations	
Thyroid-stimulating hormone (TSH)—RIA	0–15 mIU/L	0–15 mIU/L	Hypothyroidism	Hyperthyroidism
Thyroid-binding globulin	16–32 mcg/dL	120–180/mcg/L	Hypothyroidism, pregnancy, estrogen therapy, oral contraceptive use, and genetic and idiopathic liver disease	Use of androgens and anabolic steroids, nephrotic syndrome, and marked hypoproteinemia
Transferrin	200–380 mg/dL	2.3–3.2 g/L	Pregnancy, iron deficiency anemia due to hemorrhaging, acute hepatitis, polycythemia, and oral contraceptive use	Pernicious anemia in relapse, thalassemic and sickle cell disease, chromatosis, neoplastic and hepatic diseases, and malnutrition
Triglycerides	Males: 44–180 mg/dL Females: 10–190 mg/dL	0.44–2.01 mmol/L 0.11–2.21 mmol/L	Increased risk for atherosclerosis	
Troponin				
Troponin I	<0.35 ng/mL	<0.35 mcg/L	Myocardial infarction	
Troponin T	<0.1 ng/mL	<0.1 mcg/L	Rhabdomyolysis, and severe crushing injuries	
Tryptophan	1.4–3 mg/dL	68.6–147 nmol/L	Tyrosinosis	Tryptophan-specific malabsorption syndrome
Tyrosine	0.5–4 mg/dL	27.6–220.8 mmol/L	Acute glomerulonephritis	Severe hepatic failure
Urea nitrogen (BUN)	8–20 mg/dL	2.9–7.5 mmol/L	Obstructive uropathy, mercury poisoning, and nephrotic syndrome	Pregnancy
Uric acid	Males: 3.4–7.0 mg/dL Females: 2.4–6.0mg/dL	202–416 mcmol/L 143–357 mmol/L	Gouty arthritis, acute leukemia, lymphomas treated by chemotherapy, and toxemia of pregnancy	Defective tubular reabsorption
Viscosity	1.4–1.8 relative to water at 37°C (98.6°F)		Patients with marked increases of the gamma globulins, and hypervitaminosis A	
Vitamin A	30–120 mcg/dL	1.05–4.20 mcmol/L		Vitamin A deficiency, celiac disease, sprue, obstructive jaundice, giardiasis, and parenchymal hepatic disease
Vitamin B_1 (thiamine)	1.6–4 mcg/dL	47.4–135.7 nmol/L		Anorexia, beriberi, polyneuropathy, and cardiomyopathies
Vitamin B_6 (pyridoxal phosphate)	5–30 ng/mL	20–121 nmol/L		Chronic alcoholism, malnutrition, uremia, and malabsorption, such as celiac disease
Vitamin B_{12}—RIA	200–900 pg/mL	148–666 pmol/L	Hepatic cell damage and in association with the myeloproliferative disorders (the highest levels are encountered in myeloid leukemia)	Strict vegetarianism, alcoholism, pernicious anemia, total or partial gastrectomy, ileal resection, sprue and celiac disease, and fish tapeworm infestation
Vitamin E	0.5–1.8 mg/dL	12–42 mcmol/L		Vitamin E deficiency
Xylose absorption test	2 hr, 30–50 mg/dL	2–3.35 mmol/L		Malabsorption syndrome
Zinc	55–150 mcg/dL	7.65–22.95 mcmol/L	Coronary artery disease, arteriosclerosis, and industrial exposure	Metastatic liver disease, tuberculosis, and sprue

[a]By radioimmunoassay.
[b]Varies among methods.

TABLE A-3 Reference Ranges—Immunodiagnostic Test

Test	Normal Value	Clinical Significance
Acetylcholine receptor binding antibody	Negative or <0.03 nmol/L	Considered to be diagnostic for myasthenia gravis in patients with symptoms
Anti–ds-DNA antibody	<70 U by enzyme-linked immunosorbent assay (ELISA) <1:20 by indirect fluorescence	Valuable in supporting diagnosis or monitoring disease activity and prognosis of systemic lupus erythematosus (SLE)
Antiglomerular basement membrane antibody	Negative or <5 UL	Primarily used in the differential diagnosis of glomerular nephritis induced by antiglomerular basement membrane antibodies from other types of glomerular nephritis
Anti-insulin antibody	<3% binding of labeled beef and pork insulin by patient's serum; or <9 mIU/L	Helpful in determining the best therapeutic agent in patients with diabetes and the cause of allergic manifestations. Also used to identify insulin resistance
Antinuclear antibody (ANAs)	Negative, <1:40	Increased in SLE, chronic hepatitis, scleroderma, leukemia, and mononucleosis
Antiparietal cell antibody	Negative	Helpful in diagnosing chronic gastric disease and differentiating autoimmune pernicious anemia from other megaloblastic anemias
Antiribonucleoprotein antibody	Negative	Helpful in differential diagnosis of systemic rheumatic disease
Antiscleroderma antibody	Negative	Highly diagnostic for scleroderma
Anti-Smith antibody	Negative	Highly diagnostic of SLE
Anti–SS-A/anti–SS-B antibody	Negative	SS-A antibodies are found in Sjögren syndrome alone or associated with lupus SS-B antibodies are associated with primary Sjögren syndrome
Antithyroglobulin and antimicrosomal antibodies	<1:100 titer by gelatin or hemagglutination	Presence and concentration is important in evaluation and treatment of various thyroid disorders, such as Hashimoto thyroiditis and Graves' disease. May indicate previous autoimmune disorders
CA 15–3 tumor marker	<30 IU/mL	Increased in metastatic breast cancer
CA 19–9 tumor marker	<37 IU/mL	Increased in pancreatic, hepatobiliary, gastric, and colorectal cancer, gallstones
CA 125	0–35 IU/mL	Increased in colon, upper gastrointestinal (GI), ovarian, and other gynecologic cancers: pregnancy, peritonitis
Carcinoembryonic antigen (CEA)—RLK	0–2.5 mcg/L (nonsmoker) 0–5 mcg/L (smoker)	The repeatedly high incidence of this antigen in cancers of the colon, rectum, pancreas, and stomach suggests that CEA levels may be useful in the therapeutic monitoring of these conditions, but it is not a screening test
Cold agglutinins	Negative or <1:64	Increased in mycoplasma pneumonia, viral illness, mononucleosis, multiple myeloma, scleroderma
C-reactive protein	<1 mg/dL (<10 mg/L)	Increase indicates active inflammation
High sensitivity assay for C-reactive protein (hs-CRP)	0.2–8.0 mg/L	Cardiovascular disease risk
Cytomegalovirus antibodies (CMV IgG)	Negative: <0.9 units/mL	Positive >1:0 unit/mL if exposed to CMV at any time. Acute and convalescent specimens can help identify acute infection
Cytomegalovirus antibodies (CMV IgM)	Negative: <0:79 Equivocal: 0:80–1.20	Positive >1:20 usually indicates acute infection Repeat specimen in 1–2 weeks for equivocal result
Epstein–Barr virus serology (viral capsid antigen IgG and IgM, early antigen IgG, and nuclear antigen IgG)	Negative	Differentiation of acute from chronic or old infection
Hepatitis A virus antibodies, IgM (HAV-Ab/IgM)	Negative	Positive in acute-stage hepatitis A; develops early in disease
Hepatitis A virus antibodies, IgG (HAV-Ab/IgG)	Negative	Positive if previous exposure and immunity to hepatitis A
Hepatitis B surface antigen (HBsAg)	Negative	Positive in acute-stage hepatitis B
Hepatitis B surface antibody (HBsAb)	Negative	Positive if previous exposure and immunity to hepatitis B
Hepatitis C virus antibodies	Negative	Positive in exposure to hepatitis C virus; may indicate acute, chronic, or cleared infection
Hepatitis C virus RNA	Negative	Positive in hepatitis C infection, can be quantitative
Homocysteine	0.54–2.30 mg/L (4–17 mcmol/L)	Cardiovascular disease risk Folic acid deficiency Vitamin B_{12} deficiency
Infectious mononucleosis tests (monospot, monotest, heterophile antigen test, Epstein–Barr virus [EBV], antiviral capsid antigen IgM and IgG)	Negative	Positive monospot and monotest are presumptive, positive EBV IgM and IgG indicate acute and recent or past infection, respectively

(*Continued*)

TABLE A-3 (*Continued*)

Test	Normal Value	Clinical Significance
Lyme disease titer	Negative, <1:256 by indirect fluorescent antibody method; nonreactive by ELISA	Positive results help diagnose Lyme disease. False positive may occur with high rheumatoid factor titers or syphilis Positive ELISA confirmed by Western blot test
Pyroglobulin test	Negative	These abnormal proteins may be associated with myeloma, lymphoma, polycythemia vera, and SLE
Rheumatoid factor	Negative	Elevated in rheumatoid arthritis, lupus endocarditis, tuberculosis, syphilis, sarcoidosis, cancer
T- and B-cell lymphocyte surface markers T-helper/T-suppressor ratio	T- and B-cell lymphocyte surface markers: Percent T cells (CD2) 60%–88% Percent helper cells (CD4) 34%–67% Percent suppressor cells (CD8) 10%–42% Percent B cells (CD19) 3%–21% Absolute counts: Lymphocytes 0.66–4.60 thou/mL T cells 644–2201 cells/mL Helper cells 493–1191 cells/mL Suppressor T cells 182–785 cells/mL B cells 92–392 cells/mL Lymphocyte ratio: T_H/T_S ratio >1	Used to evaluate immune system by identifying the specific cells involved in the immune response. Valuable in diagnosis of lymphocytic leukemia, lymphoma, and immunodeficiency diseases including AIDS, and in the assessment of patient response to chemotherapy and radiation

TABLE A-4 Reference Ranges—Urine Chemistry

	Normal Adult Reference Range		Clinical Significance	
Test	Conventional Units	SI Units	Increased	Decreased
Acetone and acetoacetate	Zero		Diabetic ketoacidosis, starvation.	
Aldosterone	With normal salt diet: Normal: 3–19 mcg/24 hr Reno vascular: 10–40 mcg/24 hr Tumor: 20–100 mcg/24 hr	 11.1–55.5 nmol/24 hr 8–51 nmol/24 hr 55.4–277 nmol/24 hr	Primary aldosteronism (adrenocortical tumor), secondary aldosteronism, salt depletion, potassium loading ACTH in large doses, heart failure, cirrhosis with ascites formation, nephrosis, pregnancy	
Alpha amino nitrogen	50–200 mg/24 hr	3.6–14.3 nmol/24 hr	Leukemia, phenylketonuria, other metabolic diseases	
Amylase	1–17 units excreted per hr	0.017–0.29 U/hr	Acute pancreatitis	
Arylsulfatase A	1 hour test 2–19 U/mL 24-hour test 170–2000/24 hours	2–19 units/hr 2.89–34 mckat/L		
Calcium	100–250 mg/24 hr	2.5–6.2 mmol/24 hr	Hyperparathyroidism, Vitamin D intoxication, Fanconi syndrome	Hypoparathyroidism
Catecholamines	Total: 0–275 mcg/24 hr Epinephrine: 0%–20% Norepinephrine: 60%–90%	0–275 mcg/24 hr Fraction total: 0–20 mcg/24 hr Fraction total: 0.60–0.90	Pheochromocytoma Neuroblastoma	Vitamin D deficiency
Chorionic gonadotrophin, qualitative (pregnancy test)	Negative		Pregnancy, chorionepithelioma, hydatidiform mole	
Copper	15–60 mcg/24 hr	0.22–0.9 mcmol/24 hr	Wilson disease, cirrhosis, nephrosis	
Coproporphyrin	50–300 mcg/24 hr	0.075–0.45 mcmol/24 hr	Poliomyelitis, lead poisoning, porphyria	
Cortisol, free	<50 mcg/24 h	<138 nmol/24 hr	Cushing syndrome	
Creatinine	Males: 14–16 mg/kg body weight/24 hr Females: 11–20 mg/kg body weight/24 hr	124–230 mmol/kg body weight/24 hr 97–177 mmol/kg body weight/24 hr	Muscular dystrophy Fever, carcinoma of liver, pregnancy, hyperthyroidism, myositis	
Creatine	0–270 mg/24 hr	0–2.05 mmol/24 hr	Typhoid fever, salmonella infections, tetanus	Muscular atrophy, anemia, advanced degeneration of kidneys, leukemia

(*Continued*)

(*Continued*)

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
Creatinine clearance	Males: 85–125 mL/min Females: 75–115 mL/min	1.42–2.08 mL/s 1.25–1.92 mL/s		Renal diseases
Cystine and cysteine	10–100 mg/24 hr	0.08–0.83 mmol/24 hr	Cystinuria	
Delta aminolevulinic acid	1.5–7.5 mg/dL	11–57/mcmol/day	Lead poisoning, porphyria hepatica, hepatitis hepatic carcinoma	
11-Desoxycortisol	20–100 mcg/24 hr	0.6–2.9 unit/24 hr	Hypertensive form of virilizing adrenal hyperplasia due to an 11-beta hydroxylase defect.	
Estriol (placental)	Weeks of pregnancy 12 16 20 24 28 32 36 40	mcm/24 hr <1 2–7 4–9 6–13 8–22 12–43 14–45 19–46	mmol/24 hr <3.5 7–24.5 14–32 21–45.5 28–77 42–150 49–158 66.5–160	Decreased values occur with fetal distress of many conditions, including preeclampsia, placental insufficiency, and poorly controlled diabetes
Estrogens, total (fluorometric)	Females: Onset of menstruation: 4–25 mcg/24 hr Ovulation peak: 28–100 mcg/24 hr Luteal peak: 22–105 mcg/24 hr Menopausal: 1.4–19.6 mcg/24 h Males: 5–18 mcg/24 h	 4–25 mcg/24 hr 28–100 mcg/24 hr 22–105 mcg/24 hr 1.4–19.6 mcg/24 hr 5–18 mcg/24 hr	Hyperestrogenism due to gonadal or adrenal neoplasm	Primary or secondary amenorrhea
Etiocholanolone	Males: 1.9–6 mg/24 hr Females: 0.5–4 mg/24 h	6.5–20.6 mcmol/24 hr 1.7–13.8 mcmol/24 h	Adrenogenital syndrome Idiopathic hirsutism	
Follicle-stimulating hormone—RIA	Females: Follicular: 5–20 IU/24 hr Luteal: 5–15 IU/24 hr Midcycle: 15–60 IU/24 hr Menopausal: 50–100 IU/24 hr Males: 5–25 IU/24 hr	 5–20 IU/d 5–15 IU/d 15–60 IU/d 50–100 IU/d 5–25 IU/d	Menopause and primary ovarian failure	Pituitary failure
Glucose	Negative		Diabetes, pituitary disorders, increased ICP, lesion in floor of 4th ventricle	
Hemoglobin and myoglobin	Negative		Extensive burns, ransfusion of incompatible blood, myoglobin increased in severe crushing injuries to muscles	
Homovanillic acid		5.5–27.5 mcmol/d	Neuroblastoma	Addison disease
17-hydroxycorticosteroids	8 mg/24 hr 2–10 mg/24 hr	5.5–27.5 mcmol/d	Cushing syndrome	Anterior pituitary hypofunction
5-Hydroxyindoleacetic acid, qualitative	Negative		Malignant carcinoid tumors	
17-ketosteroids, total	Males: 4–14 mg/24 hr Females: 2–12 mg/24 hr	35–76 mcmol/24 hr 21–55 mcmol/24 hr	Interstitial cell tumor of testes, simple hirsutism, occasionally adrenal hyperplasia, Cushing syndrome, adrenal cancer, virilism, adrenoblastoma	Thyrotoxicosis, female hypogonadism, diabetes, hypertension, debilitating disease of mild to moderate severity, eunuchoidism, Addison disease, panhypopituitarism, myxedema, nephrosis
Lead	<125 mcg/24 hr	<60 mcmol/24 hr	Lead poisoning	
Luteinizing hormone	Males: 5–18 IU/24 hr Females: Follicular phase: 2–25 IU/24 hr Ovulatory peak: 30–95 IU/24 hr Luteal phase: 2–20 IU/24 hr Postmenopausal: 40–110 IU/24 hr	 2–25 IU/d 30–95 IU/d 2–20 IU/d 40–110 IU/d	Pituitary tumor, ovarian failure	Failure of pituitary or hypothalamus, anorexia nervosa

(*Continued*)

TABLE A-4 (*Continued*)

Test	Normal Adult Reference Range		Clinical Significance	
	Conventional Units	SI Units	Increased	Decreased
Metanephrines, total	<1.4 mg/24 hr	<7 mcmol/24 hr	Pheochromocytoma; a few patients with pheochromocytoma may have elevated urinary metanephrines but normal catecholamines and vanillylmandelic acid (VMA)	
Osmolality	50–1,200 mOsm/kg	50–1,200 mmol/kg	Useful in the study of electrolyte and water balance	
Oxalate	Up to 45 mg/24 hr	Up to 500/mcmol/24 hr	Primary hyperoxaluria	
Phenylpyruvic acid qualitative	Negative		Phenylketonuria	
Phosphorus, inorganic	0.9–1.3 g/24 hr	29–42 mmol/24 hr	Hypoparathyroidism, vitamin D intoxication, Paget disease, metastatic neoplasm to bone	Hypoparathyroidism, vitamin D deficiency
Porphobilinogen, qualitative	Negative		Chronic lead poisoning, acute porphyria, liver disease	
Porphobilinogen quantitative	0–1 mg/24 hr	0–4.4 mcmol/24 hr	Acute porphyria, liver disease	
Porphyrins, qualitative	Negative		See porphyrins, quantitative.	
Porphyrins, quantitative (coproporphyrin and uroporphyrin)	Coproporphyrin: 50–160 mcg/24 hr Uroporphyrin: up to 50 mcg/24 hr	0.075–0.24 mcmol/24hr Up to 0.06 mcmol/24 hr	Porphyria, lead poisoning (only coproporphyrin increased)	
Potassium	26–123 mEq/24 hr	26–123 mmol/24 hr	Hemolysis, chronic renal disease, acidosis, Cushing syndrome, corpus luteum cysts	Diarrhea, adrenocortical insufficiency
Pregnanediol	Females: Proliferative phase: 0.5–1.5 mg/24 hr Luteal phase: 2–7 mg/24 hr Menopause: 0.2–1 mg/24 hr	 1.6–4.8 mcmol/24 hr 6–22 mcmol/24 hr 0.6–3.1 mcmol/24 hr	When placental tissue remains in the uterus following parturition, some cases of adrenocortical tumors	Placental dysfunction, threatened abortion, intrauterine death
Pregnancy: Weeks of gestation	mg/24 hr	mcmol/24 hr		
10–12	5–15	15.6–47		
12–18	5–25	15.6–78.0		
18–24	15–33	47.0–103.0		
24–28	20–42	62.4–131.0		
28–32	27–47	84.2–146.6		
Pregnanetriol	Females: 0.1–2.2 mg/24 hr Males: 0.4–2.5 mg/24 hr	0.3–6.5 mcmol/24 hr 1.2–7.5 mcmol/24 hr	Congenital adrenal androgenic hyperplasia	
Protein	<150 mg/24 hr	<150 mg/24 hr	Nephritis, heart failure, mercury poisoning, Bence Jones protein in multiple myeloma, febrile states, hematuria	
Sodium	75–200 mEq/24 hr	75–200 mmol/24 hr	Useful in detecting gross changes in water and salt balance	
Titratable acidity	20–40 mEq/24 hr	20–40 mmol/24 hr	Metabolic acidosis	Metabolic alkalosis
Urea nitrogen	9–16 gm/24 hr	0.32–0.57 mol/L	Excessive protein catabolism	Impaired kidney function
Uric acid	250–750 mg/24 hr	1.48–4.43 mmol/24 hr	Gout	Nephritis
Urobilinogen	Random urine: <0.25 mg/dL 24-hour urine: up to 4 mg/24 hr	<0.42 mol/24 hr Up to 6.76 mcmol/24 hr	Liver and biliary tract disease, hemolytic anemias	Complete or nearly complete biliary obstruction, diarrhea
Vanillylmandelic acid (VMA)	0.7–6.8 mg/24 hr	3.5–34.3 mcmol/24 hr	Pheochromocytoma, neuroblastoma, ingestion of coffee, tea, aspirin, bananas, and several different drugs	Renal insufficiency
Xylose absorption test (5-hour)	16%–33% of ingested xylose	Fraction absorbed: 0.16–0.33		
Zinc	0.15–1.2 mg/24 hr	2.3–18.4 mcmol/24 hr		Malabsorption syndromes

TABLE A-5 Selected Reference Ranges—Cerebrospinal Fluid (CSF)

	Normal Adult Reference Range		Clinical Significance	
Test	Conventional Units	SI Units	Increased	Decreased
RBCs	None	None	Any RBCs are due to traumatic tap or subarachnoid hemorrhage	
WBCs	0–5 cells/mm^3	0–5 × 10^6/L	Tumor, meningitis, subarachnoid hemorrhage, infarct, and abscesses	
Chloride	120–130 mEq/L	120–130 mmol/L	Not neurologically significant	Acute generalized meningitis and tuberculous meningitis
Glucose	50–75 mg/100 ml	3.00–4.00 mmol/L	Not neurologically significant	Associated with bacteria in CSF
Protein	14–45 mg/100 ml	150–450 mg/L	Tubercular meningitis, neurosyphilis, poliomyelitis, Guillain–Barré syndrome, subdural hematoma, tumors, and multiple sclerosis	Can occur in hyperthyroidism and benign intracranial hypertension after removal of large amounts of CSF

RBCs, red blood cells; WBCs, white blood cells.

REFERENCES

Fischbach, F., & Dunning, M. B. (2015). *A manual of laboratory and diagnostic tests* (9th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Bader, M., Littlejohns, L. R., & Olson, D. (2016). *AANN core curriculum for neuroscience nursing* (6th ed.). Chicago, IL: American Association of Neuroscience Nurses.

Appendix B
Assessment and Management of Patients Who are LGBTQ

LEARNING OBJECTIVES

On completion of this topic, the learner will be able to:

1. Describe the importance of providing inclusive healthcare environments for people who are lesbian, gay, bisexual, transgender, and queer.
2. Use inclusive terminology when communicating and conducting an assessment with a person who is lesbian, gay, bisexual, transgender, and queer.
3. Explain and demonstrate the proper techniques to perform a health history and physical assessment and discriminate between normal and abnormal findings identified in the patient who is lesbian, gay, bisexual, transgender, and queer.
4. Describe the various medical procedures and hormone treatments available for the person who is undergoing gender reassignment.
5. Compare and contrast surgical procedures available to people seeking gender reassignment in terms of indications and preoperative and postoperative complications.
6. Use the nursing process as a framework for care of the patient who undergoes gender reassignment surgery.

NURSING CONCEPTS

Assessment
Communication
Development/Human Development
Family
Identity
Professionalism/Professional Behaviors
Sexuality

GLOSSARY

bisexual: people who are romantically, emotionally, or sexually attracted to both male and female genders
cisgender: people who identify with the gender that matches the sex assigned to them at birth
gay: people who are romantically, emotionally, or sexually attracted to the same gender, such as men attracted to men
gender: set of socially constructed norms and behaviors that are taught to women and men
gender dysphoria: distress a person feels due to a mismatch between their gender identity and sex assigned at birth
gender identity: the internal self-conception of one's gender
intersex: a term used for a person who is born with biological traits that do not fit into those that traditionally characterize either male or female
lesbian: a term that gay women, or those women who are romantically, emotionally, or sexually attracted to other women, may prefer to use
LGBTQ: acronym that stands for lesbian, gay, bisexual, transgender, and queer
queer: people who are romantically, emotionally, or sexually attracted to numerous genders (male, female, transgender, intersex, etc.) or people who identify as nonheterosexual but do not want to use labels, such as gay, lesbian, or bisexual
questioning: a person who is unsure or is still exploring their sexual orientation or is concerned about applying a social label to themselves
sex: refers to the physical or biological characteristics that distinguish women and men, such as chromosomes, genitals, and hormones
sexual orientation: umbrella term that refers to romantic, emotional, or sexual attraction to persons of the opposite gender, the same gender, or to both or more than one gender
third-person pronouns: a way of referencing a person other than the self that may or may not use gender-specific labels (e.g., he/him, she/her, they/them)
transgender: umbrella term used to describe the full range of people whose gender identity does not match with the sex assigned to them at birth
transgender man: refers to a person who was assigned a female sex at birth but identifies with a male or masculine gender
transgender woman: refers to a person who was assigned a male sex at birth but identifies with a female or feminine gender
transition: process of aligning a person's gender expression with their self-identified gender identity, which can include social, medical, surgical, and legal changes

Introduction

People who are **LGBTQ** (lesbian, gay, bisexual, transgender, and queer) have unique health care needs. They also experience particular health risks and disparities based on sexuality and gender identity. Increasingly, nursing and medical professionals are recognizing these risks and disparities; furthermore, these professionals are acknowledging the importance of providing culturally appropriate care to people who identify as LGBTQ. Nurses will encounter people who are LGBTQ and their families in every practice setting. As they would for other diverse populations, nurses should be prepared to provide quality and culturally appropriate care. This appendix focuses on the terminology around sexuality and gender identity, culturally appropriate assessment and communication, and assessment and management of patients who identify as LGBTQ, and, in particular, the unique health care needs of those patients seeking gender reassignment. The management of patients seeking gender reassignment using both nonsurgical and surgical treatments is discussed.

Sexuality and Gender Identity

Understanding the meaning and significance of the concepts and terminology for sexuality and gender identity is important to caring for patients who are LGBTQ.

Sexuality

Human sexuality is the way people experience and express themselves sexually. This involves biological, physical, emotional, or social feelings. Sexual orientation, which is a component of sexuality, is different than gender (see discussion below). **Sexual orientation** is an umbrella term that refers to romantic, emotional, or sexual attraction to persons of the opposite gender, the same gender, or to more than one gender. There are many terms that people use to describe their sexual orientation; however, the most commonly used terms are *heterosexual* or *straight*, *gay* or *lesbian*, *bisexual*, and *queer*.

People who are attracted to a different gender, such as women who are attracted to men, typically identify as heterosexual or straight. People who are attracted to the same gender, such as men attracted to men, often identify as gay. Gay women may prefer the term **lesbian**. People who are attracted to both male and female genders usually identify as **bisexual**.

Although the term *queer* was historically used as a word of insult, many people now choose to use it to identify their sexual orientation. People who are **queer** typically experience attractions to numerous genders (male, female, transgender, intersex, etc.). A person who does not want to use labels, such as gay, lesbian, or bisexual, may also use the term queer to identify as a nonheterosexual.

People who are exploring or are unsure of their sexual orientation may refer to themselves as **questioning**. Questioning one's own sexuality can be difficult and confusing and can take years to understand. This term can also apply to people who are concerned about applying a social label (e.g., gay, lesbian, bisexual, queer) to themselves and may prefer to use this term.

Gender Identity

To fully understand the term *gender identity*, the concepts of *sex* and *gender* must be discussed first. **Sex** in the context of gender identity refers to the physical or biological characteristics that distinguish women and men, such as chromosomes, genitals, and hormones (Eliason & Chinn, 2018). For example, women have XX chromosomes, a uterus and ovaries, and the primary sex hormone is estrogen; whereas, men have XY chromosomes, a penis and testicles, and the primary sex hormone is testosterone. In most societies, people are assigned either the male or female sex at birth. However, some persons do not clearly have these defined binary sets of sex chromosomes or may not have clearly distinguishable genitalia. **Intersex** is a term used for a person who is born with biological traits that do not fit into those that traditionally characterize either male or female.

Gender is a set of socially constructed characteristics of women and men (World Health Organization, 2019). Although a person is either assigned as male or female at birth based on sex characteristics, they are taught norms and behaviors that are appropriate for their gender. Gender is usually the first thing we notice about a person based on cues, such as voice, communication style, hairstyle, clothing, and mannerisms. Gender norms, behaviors, and cues vary from society to society and can be changed.

Gender identity refers to how a person feels about themselves or their self-concept as female or male, feminine or masculine, or as something on the continuum between the two extremes (Eliason & Chinn, 2018). **Cisgender** is a term that often refers to people who identify with the gender that matches the sex assigned to them at birth (e.g., a person with a female sex that identifies as a woman). **Transgender** is an umbrella term used to describe the full range of people whose gender identity does not match with the sex assigned to them at birth. Although there is a diversity of terms that transgender people may use to identify their gender (e.g., trans, gender nonconforming, agender, and genderqueer), this appendix will use two main terms: transgender woman and transgender man. **Transgender woman**, or male to female, refers to a person who was assigned a male sex at birth but identifies with a female or feminine gender. **Transgender man**, or female to male, refers to a person who was assigned a female sex at birth but identifies with a male or masculine gender.

It is important to remember that gender identity and sexual orientation are two different self-concepts. Sexual orientation refers to a person's attraction, and gender identity refers to how a person feels about their gender. For example, a transgender man who is attracted only to men has a male gender identity and a gay sexual orientation. Health care professionals should never assume a person's sexual orientation or gender identity based on physical characteristics, mannerisms, communication style, voice, clothing, or hairstyle.

Health Risks

The root cause of health risks or disparities among people who are LGBTQ is stigma (i.e., negative and unfair beliefs).

As compared to people who are heterosexual and cisgender, people who are LGBTQ are at greater risk for certain physical and mental health issues. In terms of mental health disorders, people who are LGBTQ have a higher rate of depression and anxiety (Bostwick, Hughes, Steffen, et al., 2019); (Ross, Salway, Tarasoff, et al., 2018); (Witcomb, Bouman, Claes, et al., 2018) and experience more suicidality (Lyons, Walters, Jack, et al., 2019); (McNeil, Ellis, & Eccles, 2017). Nearly 50% of people who are transgender have reported suicide attempts. Moreover, people who are LGBTQ tend to experience more victimization, such as physical or verbal harassment, which is associated with higher rates of depression and suicidality (Burks, Cramer, Henderson, et al., 2018).

Women who are lesbian, bisexual, or queer tend to be at greater risk for obesity and cardiovascular disease as compared to heterosexual women (Simoni, Smith, Oost, et al., 2017). Obesity in women who are lesbian, bisexual, or queer is linked to dysregulated eating, such as emotional- or binge-eating. The causes of dysregulated eating are complex and include biological, psychological, and social factors. In women who are lesbian, bisexual, or queer, stigma is one of the root causes of obesity. Stigmatizing experiences, such as discrimination or victimization, leads to emotional distress, which in turn is associated with dysregulated eating as a coping strategy (Mason, Smith, & Lavender, 2019).

Men who are gay or bisexual and transgender women have higher rates of infection with the human immune deficiency virus (HIV) as compared to the general population. Men who are gay or bisexual is the population most affected by HIV in the United States (Centers for Disease Control and Prevention [CDC], 2019a). People who are transgender receive an HIV diagnosis at three times the rate of the national average (CDC, 2019b). Among these populations, rates of HIV are even higher among certain subgroups, especially people who are African American and young adult (see Chapter 55 for further discussion on HIV).

Assessment

Nurses should strive to create a welcoming, inclusive, and therapeutic relationship with every patient. To better achieve this type of relationship with people who are LGBTQ, nurses should use inclusive terms and language. This will increase the likelihood of eliciting accurate information from anyone whose experience is different from cultural norms (Eliason & Chinn, 2018). Using inclusive language conveys to the person who is LGBTQ that the interviewer is open to hearing about their sexuality, gender identity, and relationships. If a nurse does not yet know a patient's sexual orientation and gender identity, they should always use neutral language to ensure the patient is comfortable during the assessment (see the Resources section at the end of the appendix for educational materials that promote developing welcoming and inclusive patient–provider relationships).

All over the world, people tend to communicate using a binary gender system (female or male) and based on the assumption that people are heterosexual. This type of communication practice can be harmful to people who are LGBTQ, especially in the health care setting. Nurses should strive to use language terms that avoid assumptions about a patient's gender identity and sexual orientation. For example, nurses should avoid using singular **third-person pronouns** (a way of referencing a person other than the self that may use gender-specific labels) and salutations that use gender-specific labels (e.g., sir/miss/madam, Mr./Mrs./Ms.) until confirming the patient's preferences. They should also avoid using terms that assume sexual orientation of the patient and their family (e.g., wife/husband, boyfriend/girlfriend, mother/father). Table B-1 provides specific examples of neutral questions and statements.

Nurses should routinely assess each patient's sexual orientation and gender identity (SO/GI), including preferred pronouns. Assessing for SO/GI in the health care setting facilitates the provision of enhanced, holistic, person-centered care. For example, people who are LGBTQ may have unique health risks that need attention or may have a diverse family structure.. Thus, nurses should be skilled at properly assessing for SO/GI and preferred pronouns (Chart B-1).

Assessing for family structure and other important relationships should be routine for every patient. People who are LGBTQ may have diverse or nontraditional family structures and may include people who are not biologically related. Nurses should assess for family and family of choice. Family of choice is a commonly used term among people who are LGBTQ. Some people who are LGBTQ have been rejected by their family of origin and thus create their own family network of people who support and care for them (Eliason & Chinn, 2018). Moreover, some people who are LGBTQ fear discrimination and exclusion of not only themselves but also their family. (Eliason & Chinn, 2018).

It is best to start the interview with an open-ended question, such as "Tell me about your family and social support system." As the nurse asks follow-up questions, neutral terms should be used when inquiring about partners/significant others and parents/guardians (examples are listed in Table B-1). Also, the nurse should not assume a person who is LGBTQ does not have children. Many people who are LGBTQ have children through adoption, surrogacy, and previous relationships. If the patient has children, the nurse should avoid making assumptions about the family structure. Finally, the nurse should mirror the language and terms used by the patient and their family. For example, if a male-identifying patient refers to his significant other as "husband," the nurse should not choose to use a different term, such as "partner."

In terms of health assessment, people who are LGBTQ typically do not require specific assessments or diagnostic tests. They should receive nursing and medical person-centered care like any other patient. Depending on the health care setting, the nurse may want to focus parts of their assessment on those health risks mentioned earlier. Time could be spent asking the person who is LGBTQ about anxiety, depression, suicidality, and discrimination and victimization. Since gay and bisexual men and transgender women have higher rates of HIV, sexual activity, safe sex practices, and HIV status should be assessed. People who identify as transgender should be asked about hormone treatment and surgical procedures only if it is relevant to the care being provided.

Chart B-1 PERSONAL INFORMATION

The nurse introduces these assessment questions by stating:

- "I am going to ask you a few questions about your sexual orientation and gender identity so we can provide personalized and affirmative care to you. These are questions I ask every patient. If you do not feel comfortable answering these questions, we can skip them."

The nurse assesses for gender identity using a two-step question:

- "What sex was listed on your birth certificate?"
- "What is your current gender identity?" or "How do you describe your gender identity?"

Assessing for pronouns:

- "What pronouns do you prefer we use?"
- If the patient is unsure of what this means, you can ask, "Do you use the pronouns he/him, she/her, or something else?"

Assessing sexual orientation:

- "What is your sexual orientation?" or "How do you describe your sexual orientation?"

Assessing for preferred name:

- "What name do you preferred to be called?" or "What is the name that you would like us to use?"

Adapted from Centers for Disease Control and Prevention (CDC). (2020). Collecting sexual orientation and gender identity information. Retrieved on 4/20/2020 at: www.cdc.gov/hiv/clinicians/transforming-health/health-care-providers/collecting-sexual-orientation.html; The Fenway Institute. (2017). Collecting sexual orientation and gender identity (SO/GI) data in electronic health records. Retrieved on 4/20/2020 at: www.lgbthealtheducation.org/wp-content/uploads/2017/05/SOGI-Office-Hours-Update-Final.pdf; The Fenway Institute. (2018). Ready, set go! Guidelines and tips for collecting patient data on sexual orientation and gender identity. Retrieved on 4/21/2020 at: www.lgbthealtheducation.org/wp-content/uploads/2018/03/Ready-Set-Go-publication-Updated-April-2018.pdf

TABLE B-1 Sample Questions and Statements Using Gender-Neutral Language

Question/Statement	Question/Statement with Neutral Language
Good morning, sir.	Good morning.
How may I help you, ma'am?	How may I help you?
She is scheduled for an x-ray.	They are scheduled for an x-ray.
Do you have a husband?	Are you in a relationship?
What are the names of your mom and dad?	What are the names of your parents or guardians?

Assessment and Management of Patients Seeking Gender Reassignment

People who are transgender may experience **gender dysphoria**, which is the distress caused by the dissonance between the person's gender identity and that person's sex assigned at birth. To assist people with this distress and find a gender role that is comfortable for them, treatment is available and may include medical and surgical interventions. Treatment is individualized, meaning that interventions that effectively alleviate gender dysphoria in one patient may not work for a different patient.

Health care teams who provide psychological, medical, and surgical treatments to people who are transgender often follow the Standards of Care published by the World Professional Association for Transgender Health (WPATH, 2012). Other important resources include the Guidelines for the Primary and Gender-Affirming Care of Transgender and Gender Nonbinary People from the University of California, San Francisco (Deutsch, 2016) and the Principles of Transgender Medicine and Surgery (Ettner, Monstrey, & Coleman, 2016) (see References and Resources sections at the end of the appendix).

Providing treatment to people who are seeking gender reassignment almost always starts with confirming a diagnosis of gender dysphoria. Many health insurance companies require a gender dysphoria or related diagnosis before covering the costs of gender reassignment treatments. Gender dysphoria is a diagnosis in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5). Chart B-2 lists the criteria used to diagnose a person with gender dysphoria. In short, to be diagnosed with gender dysphoria, a person must exhibit specific thoughts and feelings about the incongruence of their gender identity and their secondary sex characteristics for a period of at least 6 months (American Psychiatric Association, 2013). An experienced mental health care professional, such as psychologist, or psychiatrist, can assess, diagnose, and provide psychological treatment for gender dysphoria. Before a health care provider prescribes medical or surgical treatments (e.g., hormones, gender reassignment surgery), they usually require that the person has consulted with a mental health care provider and received a diagnosis of gender dysphoria.

When a person wants to address the distress or other negative emotions associated with having a gender that does not align with their sex assigned at birth (gender dysphoria), they will usually work with an interdisciplinary health care team. This team typically includes a mental health care professional, a health care provider experienced in endocrinology, and a surgeon. The mental health care professional will provide psychological support to the person during their gender identity journey; the endocrinology health care provider will prescribe hormones and monitor outcomes; the surgeon will handle gender reassignment surgeries. Depending on the treatment settings, nurses are involved in various capacities along the treatment continuum.

Chart B-2 DSM-5[a] DIAGNOSTIC CRITERIA FOR GENDER DYSPHORIA IN ADOLESCENTS AND ADULTS

A. A marked incongruence between one's experienced/expressed gender and assigned gender, of at least 6 months duration, as manifested by at least two of the following:
   1. Marked incongruence between one's experienced/expressed gender and primary and/or secondary sex characteristics (or in young adolescents, the anticipated secondary sex characteristics).
   2. A strong desire to be rid of one's primary and/or secondary sex characteristics because of a marked incongruence with one's experienced/expressed gender (or in young adolescents, a desire to prevent the development of the anticipated secondary sex characteristics).
   3. A strong desire for the primary and/or secondary sex characteristics of the other gender.
   4. A strong desire to be of the other gender (or some alternative gender different from one's assigned gender).
   5. A strong desire to be treated as the other gender (or some alternative gender different from one's assigned gender).
   6. A strong conviction that one has the typical feelings and reactions of the other gender (or some alternative gender different from one's assigned gender).

B. The condition is associated with clinically significant distress or impairment in social, occupational, or other important areas of functioning.

[a]DSM-5, Diagnostic and Statistical Manual of Mental Disorders (5th edition).

Reprinted with permission from American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: Author.

Medical Management

Hormone Therapy

In addition to alleviating gender dysphoria, the goal of hormone gender-affirming therapy is the acquisition of the secondary sex characteristics of the other gender, to the fullest extent possible (Gooren, 2016). To achieve the secondary sex characteristics of the opposite gender, sex steroids/hormones are needed. There is no known difference in sensitivity to the action of sex hormones on the basis of genetics or gonadal/sex status (Gooren, 2016), meaning that a person can develop secondary sex characteristics of the opposite gender by taking sex hormones. However, certain effects of sex hormones cannot be reversed. For example, in people who are transgender women (male to female), the previous effects of androgens on the skeleton (average greater height; size and shape of hands, feet, and jaw; and pelvic structure) cannot be reversed by hormones (Gooren, 2016) (Table B-2).

TABLE B-2 Physical Effects of Hormone Treatment for Gender Reassignment

Feminizing Hormones (Male to Female)	Masculinizing Hormones (Female to Male)
Reduction in growth and thinning of body hair	Growth of facial and body hair; scalp hair loss
Breast formation	Decrease in glandular activity of breasts
Softening of skin and decreased oiliness	Skin oiliness and acne
Increase in body fat and decrease in muscle mass	Decrease in subcutaneous fat, increase in abdominal fat, and increase in muscle mass
Testicular and prostate volume atrophy	Clitoral enlargement and vaginal atrophy
Decreased sperm production	Cessation of menses
Male sexual dysfunction	Deepening of voice

Adapted from World Professional Association for Transgender Health (WPATH). (2012). Standards of care for the health of transsexual, transgender, and gender-nonconforming people (version 7). Retrieved on 2/17/2020 at: www.wpath.org/publications/soc

For patients who are transgender women, estrogen is prescribed to produce the desired physical changes. The prescribed dose of estrogen is individualized and depends on many different factors, such as the patient's goals, risk/benefit ratio, presence of other medical conditions, presence or absence of gonads, and social and economic issues (WPATH, 2012). Estrogen treatment should produce changes in body hair, breast development, skin, body fat composition, muscle mass, testes, and prostate. In addition to estrogen, androgen-reducing medications to reduce testosterone levels are also often prescribed, which diminish masculine characteristics and minimize the dosage of estrogen needed to suppress testosterone. Common androgen-reducing medications include spironolactone, cyproterone acetate, GnRH agonists (e.g., goserelin, buserelin, triptorelin), and 5-alpha reductase inhibitors (e.g., finasteride, dutasteride) (WPATH, 2012). Progestogen does not add to the feminization process and is typically not recommended due to the higher incidence of breast cancer and cardiovascular disease (Gooren, 2016). See Table B-3 for commonly prescribed medications.

In people who are transgender men (female to male), testosterone is prescribed to produce the desired physical changes. Like estrogen, the prescribed dose of testosterone is individualized and depends on many different factors. Testosterone treatment should produce changes in scalp hair, skin oiliness, facial and body hair, voice, body fat composition, muscle mass, menses, clitoris, and vagina (see Tables B-2 and B-3).

As with any medical treatment, hormones carry risks to the person. The likelihood of a serious adverse event is dependent on numerous factors, such as dose, route of administration (e.g., oral vs. transdermal vs. intramuscular), and the patient's characteristics (e.g., age, comorbidities, health behaviors). People who take estrogen are at increased risk of venous thromboembolism (VTE), gallstones, elevated liver enzymes, weight gain, and hypertriglyceridemia. People who take testosterone are at increased risk for polycythemia, weight gain, acne, androgenic alopecia (male-patterned balding), and sleep apnea. In addition, both estrogen and testosterone can increase the risk of the person developing type 2 diabetes when they have additional risk factors, such as older age (WPATH, 2012).

Hair Removal

Hormone treatment does not typically fully eliminate unwanted hair, and thus people who are transgender may seek additional gender-affirming medical procedures).

Laser hair removal is the leading therapy option for long-term results and works on the principle of selective photothermolysis, whereby photons destroy the hair follicle while sparing the

TABLE B-3 Medications Prescribed to Facilitate Gender Transition

Feminizing Hormone Medications for Male to Female		
Medication	**Adverse Effects[a]**	**Nursing Considerations**
Androgen-Reducing Medications (Antiandrogen)		
Spironolactone (off-label use) Mechanism of action: diuretic that also directly inhibits testosterone secretion and androgen binding to the androgen receptor	Electrolyte imbalances, especially hyperkalemia Decreased blood pressure	This medication is a diuretic and patients must be advised of frequent urination and need to increase water intake. Caution in patients with adrenal insufficiency, diabetes, hyperkalemia, and chronic kidney disease.
Cyproterone acetate Mechanism of action: antiandrogenic and progestogenic/antigonadotropic properties, resulting in blocked binding of the active metabolite of testosterone and decreased production of testicular testosterone	Thromboembolism Hyperlipidemia Hepatotoxicity Glucose intolerance Mood changes	Assess for signs and symptoms of thromboembolism. Monitor mood changes (anxiety, depression, insomnia), especially during the first 4–6 wks. Monitor liver function tests prior to and during therapy for symptoms of hepatotoxicity.
Dutasteride Finasteride Mechanism of action: inhibits the enzyme 5-alpha reductase, which is responsible for converting testosterone to its potent metabolite	Prostatic hyperplasia	Assess for urinary hesitancy, feeling of incomplete bladder emptying, interruption of urinary stream, and dysuria.
Estrogen		
Ethinyl estradiol Mechanism of action: semisynthetic estrogen that binds to estrogen receptors, increasing estrogen levels and decreasing testosterone levels	Thromboembolism Edema Hypertension Pancreatitis	Assess for signs and symptoms of thromboembolism. Assess blood pressure before and during therapy. Monitor hepatic function during therapy.
Masculinizing Hormone Medication for Female to Male		
Medication	**Adverse Effects**	**Nursing Considerations**
Androgen		
Testosterone undecanoate Mechanism of action: synthetic testosterone that binds to androgen receptors throughout body	Hypertension Glucose intolerance	Assess blood pressure before and during therapy. Monitor for hypoglycemia, especially in people taking diabetes medications.

[a]Erectile dysfunction and gynecomastia are side effects of these medications. However, people who are male-to-female transgender are expecting these side effects.
Adapted from Comerford, K. C., & Durkin, M. T. (Eds.). (2020). Nursing2020 drug handbook. Philadelphia, PA: Wolters Kluwer.

surrounding tissue (Thomas & Houreld, 2019). The main risks of this procedure are overheating resulting in redness, blisters, and burns. Treatments should be avoided when photosensitizing medications are being used, such as acne medications (e.g., isotretinoin, minocycline, doxycycline), antibiotics (e.g., tetracyclines, sulfonamides, quinolones), and spironolactone. Nurses should review a patient's medication list and identify those that are photosensitive. Electrolysis involves the use of an electric current that destroys the root of individual hair follicles. This treatment is more time consuming and more painful than laser hair removal. The main risks of electrolysis are redness and pigment changes. To help manage the pain during laser hair removal and electrolysis, topical anesthetics (lidocaine-containing products) and acetaminophen/paracetamol are used (Reeves Deutsch, & Stark, 2016).

Acne Treatment

In transgender men, testosterone is the mainstay of masculinizing hormonal therapy. Although the exact mechanism in the pathogenesis of acne is not yet fully understood, testosterone increases the production of sebum (oily secretion) in sebaceous glands, leading to acne. Facial acne in transgender men who use testosterone peaks within the first 4 months of treatment; over 80% of testosterone-treated transgender men experience facial acne in the first year (Motosko, Zakhem, Pomeranz, et al., 2018). General guidelines for acne treatment can be followed for transgender men (Thiboutot, Dréno, Abanmi, et al., 2018); however, there are some specific considerations and risks. First, combining testosterone with some acne medications, especially minocycline, may lead to hepatotoxicity; thus, frequent monitoring of liver function tests is warranted. Second, some acne medications are teratogenic, such as minocycline, doxycycline, and isotretinoin. For transgender men who are still at risk of pregnancy (intact uterus and ovaries), careful sexual history and counseling should be performed before the initiation of any acne treatment. Third, some acne medications, especially isotretinoin, may delay wound healing and lead to keloid formation after surgery; thus, a discussion about surgical plans is needed before starting acne treatment (Motosko et al., 2018).

Fertility and Reproductive Health

Many people who are transgender will want to have biological children, but because hormone treatment limits fertility, patients should be educated about their options before starting hormone treatment or undergoing surgery to remove or alter their reproductive organs. Although the long-term effects of gender-affirming hormone therapy using testosterone or estrogen on fertility are not known, limited research suggests that testosterone and estrogen can affect the reproductive abilities of ovaries and testes, respectively (Cheng, Pastuszak, Myers, et al., 2019). Patients who are transgender should be fully informed of the possible implications that hormones have on fertility and preservation options.

In the postpuberty age group, transgender men should be educated about oocyte cryopreservation, embryo cryopreservation, and uterus preservation. Transgender women should be educated about sperm cryopreservation.

Gerontologic Considerations

The synthesis and secretion of many endogenous hormones change and the expression of cell receptors in tissues changes in numbers and signaling capacity as the human body ages (Houlberg, 2019).. With aging, the metabolism and excretion of many drugs decrease (Ruscin & Linnebar, 2018). Sex hormones also influence the absorption, metabolism, pharmacodynamics, and adverse effects of medications (Gooren & T'Sjoen, 2018). Nurses may need to take additional precautions to monitor for adverse effects and toxicity of certain medications when working with people who are transgender and taking exogenous sex hormones. The other two considerations are cardiovascular disease and bone health. In transgender women, estrogen increases the risk of cardiovascular morbidity and mortality. Additional preventive screening is warranted in these patients and lowering the dose of estrogen in transgender women over the age of 55 should be considered. Lastly, cross-sex hormone treatment can decrease bone health in both transgender women and men (Gooren & T'Sjoen, 2018). Findings from a pilot study suggest that despite having an increased risk for osteoporosis, transgender individuals' knowledge of their risks for osteoporosis can be poor (Sedlak, Roller, van Dulmen, et al., 2017) (see the Nursing Research Profile in Chart B-3). To help reduce the risk of reduced bone mineral density, nurses should educate about osteoporosis risks and promote physical exercise and intake of vitamin D and calcium to people who are transgender and taking sex hormones (see Chapter 37 for further discussion of osteoporosis). Given these considerations, the risks of hormone treatment can be managed and rarely pose an absolute contraindication (Houlberg, 2019).

Surgical Management

People who are transgender have many different gender reassignment surgeries available to them as they **transition** from their sex assigned at birth to their gender identity (Table B-4). Just like hormone treatment, gender reassignment surgeries help reduce gender dysphoria and improve quality of life. The WPATH (2012) recommends that people who are seeking gender reassignment surgeries meet certain criteria. They recommend that the person seeking surgery have (a) persistent, well-documented gender dysphoria; (b) capacity to make a fully informed decision and to give consent for treatment; (c) age of majority in a given country; and (d) any significant medical or mental health concerns be well controlled. For certain surgeries, including hysterectomy, phalloplasty, and vaginoplasty, WPATH (2012) also recommends that the person has had 12 continuous months of hormone therapy and has had 12 continuous months of living in a gender role that is congruent with their gender identity. This is based on clinical consensus, not empirical evidence, that living 12 months in a gender role that is congruent with their gender identity gives them ample opportunity to experience and socially adjust before undergoing irreversible surgery (Colebunders, Verhaeghe, Bonte, et al., 2016).

Male-to-Female Gender Reassignment Surgeries

There are numerous different gender reassignment surgeries for transgender women (see Table B-4).

For most transgender women, breast augmentation greatly increases subjective feelings of femininity. Surgeons typically recommend the person take estrogen for at least 12 months prior to the surgery to maximize breast growth and obtain better aesthetic results.

Some transgender women choose to have genital reassignment surgery which requires two procedures, including an orchiectomy (removal of the testicles) and vaginoplasty.

Chart B-3 OSTEOPOROSIS PREVENTION AMONG TRANSGENDER PERSONS

Sedlak, C. A., Roller, C. G., van Dulmen, M., et al. (2017). Transgender individuals and osteoporosis prevention. *Orthopaedic Nursing*, 36(4), 259–268.

Purpose

Many people who are transgender take sex hormones in order to achieve desirable characteristics of the gender that they feel is consonant with their personal identity. An adverse effect of these medications is that bone mineral density can become prematurely depleted, leading to early osteoporosis. The purpose of this mixed methods pilot study was to identify osteoporosis knowledge, beliefs, and prevention behaviors among transgender adults.

Design

Participants were recruited by advertising flyers at LGBTQ community centers and by advertising via LGBTQ support groups on the Internet. In order to be included in the study, participants had to be at least 30 years of age, the age when bone mineral density is considered maximal. Eligible participants could identify with male or female gender, and had to be able to read and speak English. Thirty-one participants were recruited and consented to complete a survey, which included a series of scales such as the *Osteoporosis Knowledge Test,* the *Osteoporosis Health Belief Scale,* the *Osteoporosis Self-Efficacy Scale,* the *Dietary Calcium Rapid Assessment Tool,* and the *Yale Physical Activity Survey.* Fifteen of these participants were randomly selected to participate in online qualitative interviews that focused on their views of bone health and osteoporosis.

Findings

The majority of participants (90.3%) took sex hormones. Most participants had poor knowledge of their osteoporosis risks, with 81% receiving failing scores on the *Osteoporosis Knowledge Test.* Participants selected to partake in the interviews confirmed that their knowledge of osteoporosis and their knowledge of their osteoporosis risks were poor. Several expressed frustration that health care providers had not disclosed these risks to them previously. The mean daily dietary calcium intake for the sample was less than recommended standards as was the minutes of average daily exercise. Most participants were not taking vitamin D supplements. Of those participants who were taking vitamin D supplements, more than half were taking less than recommended dosages.

Nursing Implications

Sex hormones are commonly taken by persons who are transgender; yet, findings from this study suggest that few people who are transgender and take sex hormones have knowledge of their associated higher risk for osteoporosis. Nurses should educate people who are transgender regarding the risk for osteoporosis that is associated with sex hormones. In addition, nurses should encourage persons who are transgender and taking sex hormones to engage in strategies that can mitigate the effects of sex hormones on their bone mineral density, including increasing their dietary calcium and physical activities, and taking appropriate dosages of vitamin D supplements.

TABLE B-4 Select Gender Reassignment Surgeries

Male to Female	Female to Male
Facial feminization • Angle of mandible • Cheeks • Chin • Forehead • Nose • Upper lip	Facial masculinization • Angle of mandible • Cheekbones • Chin • Forehead
Hair transplantation	Subcutaneous mastectomy
Chondrolaryngoplasty (tracheal shave)	Hysterectomy and salpingo-oophorectomy
Voice feminization	Phalloplasty
Breast augmentation	
Orchiectomy	
Vaginoplasty	

The goals of postoperative care of the patient undergoing male-to-female genital reassignment surgery are to prevent complications and infection and to ensure patency of the neovaginal cavity. After surgery, the patient typically remains in bed for five days with a vaginal dilator in place while receiving subcutaneous low-molecular-weight heparin (LMWH) (e.g., enoxaparin; see Chapter 24 for further discussion on anticoagulation medications). After the fifth day, the dilator is periodically removed and daily cleansing of the neovaginal cavity begins. The patient will typically remain in the hospital for 8 days. After discharge, the patient is educated on how to dilate and cleanse their vaginal cavity for 3 to 6 months. Once fully healed, the patient can begin having penetrative vaginal intercourse and stop using the vaginal dilator. If the patient does not engage in regular intercourse, they will need to continue using the vaginal dilator (Colebunders, Verhaeghe, et al., 2016).

Female-to-Male Gender Reassignment Surgeries

There are also numerous different gender reassignment surgeries for transgender men (see Table B-4).

Testosterone treatment has little effect on reducing breast size, thus transgender men who desire a flat chest require a subcutaneous mastectomy. From an anatomical standpoint, subcutaneous mastectomy in transgender males is nearly identical to mastectomies for breast disease. The main difference is the removal of breast tissue and excess skin and reduction and repositioning of the nipple and areola to create an aesthetically pleasing male chest (Colebunders, D'Arpa, Weijers, et al., 2016). The complication rate of subcutaneous mastectomy is very low and carries similar risk to mastectomies for breast disease (Cuccolo, Kang, Boskey, et al., 2019) (see Chapter 58 for further discussion on mastectomy).

Some transgender men choose to have phalloplasty, which is the construction of a penis. Phalloplasty is a complicated surgery that involves numerous subprocedures.

After surgery, the patient typically remains in bed for 1 week with a suprapubic urinary diversion and transurethral catheter. The patient may be prescribed an LMWH agent, such as enoxaparin, during this time frame. However, pelvic or groin hematomas sometimes develop postphalloplasty, which must then be managed by either drains or surgical drainage, and thus the individual risks versus the benefits of prescribing an LMWH agent are carefully considered (Crane, 2016). After the 1-week mark, the transurethral catheter is removed, and the suprapubic catheter is clamped so the patient can begin voiding. The patient will typically remain hospitalized for 2 to 3 weeks after a phalloplasty for close monitoring.

Postoperative urethra fistulas and strictures/stenoses are common complications.

An alternative technique to phalloplasty is metoidioplasty, which uses the clitoris to construct a microphallus. Compared to phalloplasty, metoidioplasty has a shorter hospital stay and minimal donor site complications. However, metoidioplasty does not allow the person to void while standing nor engage in penetrative sex (Djinovic, 2018).

NURSING PROCESS

The Patient Undergoing Gender Reassignment Surgery

Assessment

Preoperatively, the nurse should first gather details about the patient's gender identity, preferred name, preferred pronouns, and surgery. A person who is undergoing gender reassignment surgery will likely feel vulnerable and emotional.

Preoperatively, the nurse ensures the patient has received education and counseling about their gender reassignment surgery, the possible risks and benefits, including complications, postsurgical outcomes, and need for possible long-term follow-up appointments. The nurse needs to assess the last time the patient took their hormone treatment (e.g., estrogen or testosterone) because certain procedures require the patient to stop hormones 2 to 3 weeks in advance of surgery. The nurse should ensure the patient completed their bowel preparation, especially in genital reassignment surgery. For patients undergoing phalloplasty, the nurse needs to assess smoking status because most surgeons require the patient to be free of tobacco products or inhaling nicotine and marijuana. (Colebunders, D'Arpa, et al., 2016). Laboratory results, including complete blood count (CBC), electrolytes, blood urea nitrogen (BUN), and creatinine, should be assessed; however, the nurse should be aware that people who receive hormones may have alterations in their laboratory values (Tollinche, Walters, Radix, et al., 2018). For patients who are transitioning, regardless of whether the transition is female to male or male to female, the upper limit for creatinine, hemoglobin and hematocrit, and alkaline phosphatase should be based on male values. For patients who are transitioning from female to male, the lower limit of hemoglobin and hematocrit should be based on male values. For patients who are transitioning from male to female, the lower limit of hemoglobin and hematocrit should be based on female values (WPATH, 2012).

Postoperatively, the nurse assesses the patient to ensure the goals for recovery are met and that the patient exhibits absence of complications secondary to the surgical procedure(s). Gender reassignment surgeries often require very specific assessments to ensure proper healing and prevent complications. It is imperative that the nurse follow the surgeon's prescribed postoperative care guidelines and educate the patient to prevent both complications and revisional surgeries (Colebunders, Verhaeghe, et al., 2016).

Diagnosis

Nursing Diagnoses

Based on the assessment data, major nursing diagnoses may include the following:

- Risk for compromised dignity associated with stigmatization
- Anxiety associated with impending surgery
- Acute pain associated with surgical procedure
- Risk for infection associated with surgical procedure
- Hope associated with gender reassignment surgery

Collaborative Problems/Potential Complications

Potential complications may include the following:

- Hemorrhage
- Venous thromboembolism (VTE)
- Tissue necrosis

Planning and Goals

The major goals for the patient include enhanced sense of dignity and respect, reduction of anxiety about the surgery and postoperative care, relief of pain, absence of infection, enhancement of hope related to life after surgery, effective peripheral tissue perfusion, and absence of postoperative complications.

Nursing Interventions

Ensuring Human Dignity

The nurse needs to promote a welcoming and safe environment for the patient undergoing gender reassignment surgery. In addition, the nurse needs to promote the use of gender-neutral language, preferred third-person pronouns, and utmost respect for the patient and their family (Johnson, Wakefield, & Garthe, 2020). The patient should be able to safely disclose their gender identity and sexual orientation. In addition, nurses and other health care providers should avoid having discussions about the patient that can be overheard by neighboring patients and staff who are not involved in care. While this principle should be applied to all patients, it is of the utmost importance to the care of people who are transgender because of concerns over discriminatory health care treatment (Tollinche et al., 2018).

People who are transgender should be roomed in accordance with their gender identity preferably in a private room.

Reducing Anxiety

The nurse provides the patient preparing for gender reassignment surgery anticipatory guidance as to what to expect during the surgery and postoperatively. The patient's preferred family should be included when possible to help reduce anxiety. Additionally, some surgery centers promote the use of relaxation techniques, such as aromatherapy, nature sounds, and relaxation exercises; the nurse should use these if available (Ertug, Olusoylu, Bal, et al., 2017).

Additionally, to help ease the patient's anxiety about postoperative care, the nurse can assist in coordinating services. People who are transgender have higher rates of anxiety and depression than cisgender people. These issues may be exacerbated during a prolonged hospital stay. Thus, the nurse should advocate for the involvement of mental health, social work, and spiritual care as needed to address all of the patient's needs (Tollinche et al., 2018).

Relieving Pain

Evidence shows that patients experiencing postoperative pain should be offered multimodal analgesia, which is the pharmacologic method of combining various groups of medications for pain relief (Manworren, Gordon, & Montgomery, 2018) (see Chapter 9 for further discussion). After surgery, patients are usually prescribed opioid (morphine, hydromorphone) and nonopioid (acetaminophen/paracetamol or NSAIDs) agents. The nurse can administer these agents as prescribed to relieve pain and discomfort. Inadequately

controlled postoperative pain can impede functional recovery and reduce quality of life (Manworren et al., 2018), thus nurses need to be vigilant about controlling the patient's pain. Patients undergoing genital reassignment surgery typically need to stay in bed for numerous days; thus, the nurse should help the patient reposition themselves to promote comfort.

Preventing and Monitoring for Infection

The patient undergoing gender reassignment surgery (e.g., older adult, weak immune system, smoker, poor nutrition, overweight) are at greater risk for developing a postsurgical infection. The nurse should follow usual procedures to prevent and monitor for infection. Preventing infection after surgery requires proper and frequent hand hygiene, maintenance of the surgical site, and administration of prescribed prophylactic antibiotics. Early signs of infection should be reported to the surgeon immediately, including increased skin redness, pain, or swelling, cloudy or discolored discharge from the surgical site, and fever.

Promoting Hope

People who are transgender often experience greater levels of depression and decreased quality of life as compared with cisgender people. However, people who undergo gender reassignment surgery often experience improved quality of life (Cai, Hughto, Reisner, et al., 2019); (Passos, Teixeira, & Almeida-Santos, 2019). The nurse should promote open communication about the patient's feelings, hopes, and goals after their gender reassignment surgery and show a positive regard and sense of hope for the patient. Additionally, the nurse may want to explore unresolved emotions or anxieties.

Monitoring and Managing Potential Complications

After surgery, the nurse assesses the patient for complications from the procedure, such as hemorrhage, VTE, and tissue necrosis.

Hemorrhage. Postoperative hemorrhage is a possible complication after gender reassignment surgery, especially following vaginectomy, which is one of the procedures during a phalloplasty (Colebunders, D'Arpa, et al., 2016). Signs and symptoms of possible hemorrhage include increased pain, frank red blood from the surgical site or rectum, increase in bloody output from any drain that might be in place (e.g., for mastectomy), and typical clinical manifestations (e.g., tachycardia, hypotension, lightheadedness, syncope).

Venous Thromboembolism. People who undergo gender reassignment surgery, especially those undergoing genital surgery and those who are transgender women, are at risk of VTE, including both pulmonary embolism (PE) and deep vein thrombosis (DVT) (Shatzel, Connelly, & DeLoughery, 2017). People who undergo genital reassignment surgery often need to stay in bed for up to 7 days, putting them especially at risk. Additionally, the estrogen hormone treatment among transgender women increases the risk. The patient is typically prescribed mechanical compression (e.g., intermittent pneumatic compression devices) and prophylactic anticoagulation with subcutaneous LMWH agents (e.g., enoxaparin) during hospitalization. Even with these prophylactic measures, some patients still develop DVT and PE, and thus the nurse should monitor for clinical signs (Colebunders, Verhaeghe, et al., 2016); (Shatzel et al., 2017) (see Chapter 24 for further discussion on VTE).

Tissue Necrosis. Tissue necrosis from vascular compromise is a complication with certain gender reassignment surgeries, including subcutaneous mastectomy and phalloplasty. After the subcutaneous mastectomy, vascular compromise may occur around the reconstructed nipple and areola (Colebunders, Verhaeghe, et al., 2016). After the phalloplasty, vascular compromise may occur in the reconstructed shaft, penis glans, or scrotum (Colebunders, D'Arpa, et al., 2016). Signs of tissue necrosis from vascular compromise include skin/tissue discoloration (blue or black), feeling cool to the touch, increased pain or decreased sensation, and poor wound healing. Tissue necrosis is a medical emergency that needs to be addressed immediately.

Promoting Home, Community-Based, and Transitional Care

Educating Patients About Self-Care. People who undergo gender reassignment surgery are typically discharged to home from the hospital within seven days after surgery. General postoperative discharge education includes promptly notifying the surgeon for a temperature greater than 38°C (100.4°F) or for the presence of unusual or bloody drainage from the wound(s). The patient is encouraged to advance the diet as tolerated at home to promote wound healing and to abstain from all tobacco products at least until the surgical wound(s) has healed. Additional education provided is dependent upon the nature of the surgery. For instance, the patient who has had a vaginoplasty or phalloplasty will receive very specific education (Charts B-4 and B-5). If the patient has had a mastectomy and has a drain in place, then the patient needs to be educated on managing the drain at home (see Chapter 58,)

The patient is discharged with specific instructions about follow-up appointments, including visits with their surgical, medical, and psychosocial providers to address their complex

Chart B-4 POSTOPERATIVE EDUCATION FOR PATIENTS WHO HAVE HAD A VAGINOPLASTY

The nurse instructs the patient about activity, bathing, swelling, hygiene, and vaginal intercourse as described below.

Activity

- Avoid strenuous activity for 6 weeks
- Avoid swimming or bike riding for 3 months
- May be uncomfortable to sit for the first month; may use donut ring to relieve pressure

Bathing

- Resume showering following first postoperative visit
- Do not submerge groin area in water for 8 weeks

Swelling

- Labial swelling is normal and will resolve in 6 to 8 weeks
- Apply ice to perineum for 20 minutes every hour while awake for 1 week postoperatively
- Increased swelling with pain should be reported to surgeon

Hygiene

- Wash hands before and after contact with genital area
- Wipe genital area from front to back to avoid contamination by bacteria from anal region

Vaginal Intercourse

- May engage in vaginal intercourse 3 months after surgery

Adapted from Meltzer, T. (2016). Vaginoplasty procedures, complications and aftercare. Retrieved on 7/10/2020 at: transcare.ucsf.edu/guidelines/vaginoplasty; University of Utah.

Chart B-5 POSTOPERATIVE EDUCATION FOR PATIENTS WHO HAVE HAD A PHALLOPLASTY

The nurse instructs the patient about activity, bathing, swelling, hygiene, and sexual activity as described below.

Activity

- Avoid strenuous activity for 6 weeks
- Do not flex at waist more than 90 degrees
- Do not lift anything heavier than 2 kg with arm with skin graft donor site

Bathing

- Lightly sponge bathe for 1 week postoperatively and then begin gently washing penis with warm soapy water
- Keep skin graft donor site dry; may use plastic bag to protect from water

Swelling

- Minor swelling is expected; however, report increased swelling in groin or change in girth of penis to surgeon

Hygiene

- Wash hands before and after contact with genital area

Sexual Activity

- Do not use penis for any sexual activities until approved by surgeon (including oral, vaginal, or anal insertion)

Adapted from Phalloplasty guide: How to prepare & what to expect during your recovery. Retrieved on 7/10/2020 at: healthcare.utah.edu/transgender-health/gender-affirmation-surgery/phalloplasty-recovery.php

needs. Nurses should advocate that these follow-up appointments be made prior to hospital discharge. Additionally, the discharge process should assist the patient in coordinating any type of necessary equipment pickup, transportation to follow-up appointments, and filling medication prescriptions, as needed.

Continuing and Transitional Care. Gender reassignment surgery is very complex, involves numerous different procedures, and can be different from surgeon to surgeon. For these reasons, it is impossible to describe every postsurgical self-care activity. The nurse needs to carefully review the discharge instructions provided by the surgical team. Genital reassignment surgery often has very specific self-care requirements of the patient. The nurse's role is to ensure the patient fully understands the self-care instructions and knows how to monitor for complications.

The patient will usually continue to see their surgeon for follow-up appointments for many months. Some procedures, such as a phalloplasty, may require follow-up appointments for up to a year after surgery. The patient will typically need lifelong hormonal treatment and should continue to follow-up with their endocrinology health care provider. Additionally, many people who undergo gender reassignment surgery continue to visit a mental health care provider for counseling.

Evaluation

Expected patient outcomes may include the following:

1. Enhanced human dignity
   a. Verbalizes feelings of satisfaction related to the level of respect given to them
2. Minimal anxiety
   a. Has facial expressions, gestures, and activity levels that reflect decreased distress
   b. Demonstrates ability to reassure self
3. Relief of pain
   a. Reports relief of pain
   b. Engages in early mobilization activities as prescribed
4. Maintenance of asepsis
   a. No evidence of infection (e.g., no fever, no leukocytosis, no increased redness or swelling of surgical sites)
5. Enhanced hope
   a. Verbalizes feelings about their quality of life after having had gender reassignment surgery
   b. Identifies future-oriented goals and hopes
6. Has no complications (no hemorrhage, VTE, or tissue necrosis)

REFERENCES

*Asterisk indicates nursing research.

Books

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: Author.

Colebunders, B., D'Arpa, S., Weijers, S., et al. (2016). Female-to-male gender reassignment surgery. In R. Ettner, S. Monstrey, & E. Coleman (Eds.). Principles of transgender medicine and surgery (2nd ed., pp. 279–317). New York: Routledge.

Colebunders, B., Verhaeghe, W., Bonte, K., et al. (2016). Male-to-female gender reassignment surgery. In R. Ettner, S. Monstrey, & E. Coleman (Eds.). Principles of transgender medicine and surgery (2nd ed., pp. 250–278). New York: Routledge.

Comerford, K. C., & Durkin, M. T. (Eds.). (2020). Nursing2020 Drug Handbook. Philadelphia, PA: Wolters Kluwer.

Eliason, M. J., & Chinn, P. L. (2018). LGBTQ cultures: What health care professionals need to know about sexual and gender diversity (3rd ed.). Philadelphia, PA: Wolters Kluwer.

Ettner, R., Monstrey, S., & Coleman, E. (2016). Principles of transgender medicine and surgery (2nd ed.). New York: Routledge.

Gooren, L. J. (2016). Hormone treatment of adult transgender people. In R. Ettner, S. Monstrey, & E. Coleman (Eds.). Principles of transgender medicine and surgery (2nd ed., pp. 167–179). New York: Routledge.

Houlberg, M. (2019). Endocrinology, hormone replacement therapy (HRT), and aging. In C. Hardacker, K. Ducheny, & M. Houlberg (Eds.). Transgender and gender nonconforming health and aging (pp. 21–35). Switzerland: Springer International Publishing.

Ruscin, J. M., & Linnebar, S. A. (2018). Pharmacokinetics in older adults. *Merck manual*. Retrieved on 2/17/2020 at: merckmanuals.com/professional/geriatrics/drug-therapy-in-older-adults/pharmacokinetics-in-older-adults

Journals and Electronic Documents

Bostwick, W. B., Hughes, T. L., Steffen, A., et al. (2019). Depression and victimization in a community sample of bisexual and lesbian women: An intersectional approach. Archives of Sexual Behavior, 48(1), 131–141.

Burks, A. C., Cramer, R. J., Henderson, C. E., et al. (2018). Frequency, nature, and correlates of hate crime victimization experiences in an urban sample of lesbian, gay, and bisexual community members. Journal of Interpersonal Violence, 33(3), 402–420.

Cai, X., Hughto, J. M. W., Reisner, S. L., et al. (2019). Benefit of gender-affirming medical treatment for transgender elders: Later-life alignment of mind and body. LGBT Health, 6(1), 34–39.

Centers for Disease Control and Prevention (CDC). (2019a). HIV and gay and bisexual men. Retrieved on 2/17/2020 at: www.cdc.gov/hiv/group/msm/index.html

Centers for Disease Control and Prevention (CDC). (2019b). HIV and transgender people. Retrieved on 2/17/2020 at: www.cdc.gov/hiv/group/gender/transgender/index.html

Centers for Disease Control and Prevention (CDC). (2020). Collecting sexual orientation and gender identity information. Retrieved on 4/20/2020 at: www.cdc.gov/hiv/clinicians/transforming-health/health-care-providers/collecting-sexual-orientation.html

Cheng, P. J., Pastuszak, A. W., Myers, J. B., et al. (2019). Fertility concerns of the transgender patient. Translational Andrology and Urology, 8(3), 209–218.

Crane, C. (2016). Phalloplasty and metoidioplasty—overview and postoperative considerations. Retrieved on 7/8/2020 at: transcare.ucsf.edu/guidelines/phalloplasty

Cuccolo, N. G., Kang, C. O., Boskey, E. R., et al. (2019). Mastectomy in transgender and cisgender patients: A comparative analysis of epidemiology and postoperative outcomes. Plastic and Reconstructive Surgery. Global Open, 7(6), e2316.

Deutsch, M. B. (2016). Guidelines for the primary and gender-affirming care of transgender and gender nonbinary people. Retrieved on 2/17/2020 at: transcare.ucsf.edu/guidelines

Djinovic, R. P. (2018). Metoidioplasty. Clinics in Plastic Surgery, 45(3), 381–386.

*Ertug, N., Olusoylu, O., Bal, A., et al. (2017). Comparison of the effectiveness of two different interventions to reduce preoperative anxiety: A randomized controlled trial. Nursing & Health Sciences, 19(2), 250–256.

*Johnson, M., Wakefield, C., & Garthe, K. (2020). Qualitative socioecological factors of cervical cancer screening use among transgender men. Preventive Medicine Reports, 17, 101052.

Lyons, B. H., Walters, M. L., Jack, S. P. D., et al. (2019). Suicides among lesbian and gay male individuals: Findings from the national violent death reporting system. American Journal of Preventive Medicine, 56(4), 512–521.

*Manworren, R. C. B., Gordon, D. B., & Montgomery, R. (2018). Managing postoperative pain. American Journal of Nursing, 118(1), 36–43.

Mason, T. B., Smith, K. E., & Lavender, J. M. (2019). Stigma control model of dysregulated eating: A momentary maintenance model of dysregulated eating among marginalized/stigmatized individuals. Appetite, 132(1), 67–72.

McNeil, J., Ellis, S. J., & Eccles, F. J. R. (2017). Suicide in trans populations: A systematic review of prevalence and correlates. Psychology of Sexual Orientation and Gender Diversity, 4(3), 341–353

Meltzer, T. (2016). Vaginoplasty procedures, complications and aftercare. Retrieved on 7/10/2020 at: transcare.ucsf.edu/guidelines/vaginoplasty

Motosko, C. C., Zakhem, G. A., Pomeranz, M. K., et al. (2018). Acne: A side-effect of masculinizing hormonal therapy in transgender patients. British Journal of Dermatology, 180(1), 26–30.

Passos, T. S., Teixeira, M. S., & Almeida-Santos, M. A. (2019). Quality of life after gender affirmation surgery: A systematic review and network meta-analysis. Sexuality Research and Social Policy, 17(2), 252–262.

Reeves, C., Deutsch, M. B., & Stark, J. W. (2016). Hair removal. In M. B. Deutsch (Ed.). Guidelines for the primary and gender-affirming care of transgender and gender nonbinary people. Retrieved on 2/17/2020 at: transcare.ucsf.edu/guidelines/hair-removal

Ross, L. E., Salway, T., Tarasoff, L. A., et al. (2018). Prevalence of depression and anxiety among bisexual people compared to gay, lesbian, and heterosexual individuals: A systematic review and meta-analysis. Journal of Sex Research, 55(4-5), 435–456.

*Sedlak, C. A., Roller, C. G., van Dulmen, M., et al. (2017). Transgender individuals and osteoporosis prevention. Orthopaedic Nursing, 36(4), 259–268.

Shatzel, J. J., Connelly, K. J., & DeLoughery, T. G. (2017). Thrombotic issues in transgender medicine: A review. American Journal of Hematology, 92(2), 204–208.

Simoni, J. M., Smith, L., Oost, K. M., et al. (2017). Disparities in physical health conditions among lesbian and bisexual women: A systematic review of population-based studies. Journal of Homosexuality, 64(1), 32–44.

The Fenway Institute. (2017). Collecting sexual orientation and gender identity (SO/GI) data in electronic health records. Retrieved on 4/20/2020 at: www.lgbthealtheducation.org/wp-content/uploads/2017/05/SOGI-Office-Hours-Update-Final.pdf

The Fenway Institute. (2018). Ready, set go! Guidelines and tips for collecting patient data on sexual orientation and gender identity. Retrieved on 4/21/2020 at: www.lgbthealtheducation.org/wp-content/uploads/2018/03/Ready-Set-Go-publication-Updated-April-2018.pdf

Thiboutot, D. M., Dréno, B., Abanmi, A., et al. (2018). Practical management of acne for clinicians: An international consensus from the Global Alliance to Improve Outcomes in Acne. Journal of the American Academy of Dermatology, 78(2), S1–S23.

Thomas, M. M., & Houreld, N. N. (2019). The "in's and outs" of laser hair removal: A mini review. Journal of Cosmetic and Laser Therapy, 21(6), 316–322.

Tollinche, L. E., Walters, C. B., Radix, A., et al. (2018). *The perioperative care of the transgender patient*. Anesthesia and Analgesia, 127(2), 359–366.

University of Utah. (2020). Phalloplasty guide: How to prepare & what to expect during your recovery. Retrieved on 7/10/2020 at: healthcare.utah.edu/transgender-health/gender-affirmation-surgery/phalloplasty-recovery.php

Witcomb, G. L., Bouman, W. P., Claes, L., et al. (2018). Levels of depression in transgender people and its predictors: Results of a large matched control study with transgender people accessing clinical services. Journal of Affective Disorders, 235(1), 308–315.

World Health Organization (WHO). (2019). Gender, equity and human rights. Retrieved on 2/17/2020 at: www.who.int/gender-equity-rights/knowledge/glossary/en/

World Professional Association for Transgender Health (WPATH). (2012). Standards of care for the health of transsexual, transgender, and gender-nonconforming people. Retrieved on 2/17/2020 at: www.wpath.org/publications/soc

Resources

Centers for Disease Control and Prevention (CDC) Lesbian, Gay, Bisexual, and Transgender Health, www.cdc.gov/lgbthealth/index.htm

Gay and Lesbian Medical Association, www.glma.org

Human Rights Campaign Healthcare Equality Index, www.hrc.org/hei

Lavender Health LGBTQ Resource Center, www.lavenderhealth.org

National LGBT Cancer Network, LGBT Cultural Competence Toolkit, www.lgbtcultcomp.org

National LGBT Cancer Network, *Vanessa Goes to the Doctor* training video on YouTube, produced on 3/15/2015; retrieved on 6/29/2020 at: www.youtube.com/watch?v=S3eDKf3PFRo

National LGBT Health Education Center, www.lgbthealtheducation.org/

Nurses Advancing LGBTQ Health Equality, glmanursing.org/

The Fenway Health Institute, www.fenwayhealth.org

World Professional Association for Transgender Health (WPATH), www.wpath.org.

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