Chapter 3

Physiologic Changes
Objectives

• Describe the most common structural changes observed in the normal aging process
• Discuss the impact of normal structural changes on the older adult’s self-image and lifestyle
Objectives (Cont.)

• Describe the most commonly observed functional changes that are part of the normal aging process
• Discuss the impact of normal functional changes on the older adult’s self-image and lifestyle
Objectives (Cont.)

• Identify the most common diseases related to aging in each of the body systems
• Differentiate between normal changes of aging and disease processes
• Discuss the impact of age-related changes on nursing care
Integumentary System
Expected Age-Related Changes

- Senile lentigo
- Seborrheic keratosis
- Cutaneous papilloma or skin tags
- Crow’s feet or wrinkles
- Faded hair color or gray
Expected Age-Related Changes (Cont.)

• Hair distribution patterns change
• Fingernails grow more slowly
• Toenails become thick
• Xerosis
• Senile purpura
Common Disorders Seen with Aging

- Basal cell carcinoma and melanoma
- Pressure ulcers
- Inflammation and infection
  - Rosacea
  - Contact, allergic, and seborrheic dermatitis
  - Herpes zoster
  - Fungal, yeast, and bacterial infections
  - Infestation with scabies
- Hypothermia
The Musculoskeletal System
Bones

• For the long bones to remain strong, adequate dietary intake of calcium; phosphorus; and vitamins A, C, and D is important.
• However, dietary intake of minerals alone does not maintain bone strength.
Bones (Cont.)

• It is also necessary to apply stress to the long bones to keep the minerals in the bones.
• Hormones also play an important role in bone maintenance.
  • Calcitonin, parathyroid hormone, insulin, thyroxine, estrogen, and testosterone
Vertebrae

• Consist of a series of small bones that stack up to form a strong, flexible structure
• Support the head and allows for flexible movement of the back
• The spinal cord passes through the spinal canal.
• Fibrous pads called *intravertebral disks* are located between the vertebrae and cushion the impact of walking and other activities.
Joints

- The places where bones meet
- Freely moving synovial joints are lined with cartilage, which allows free movement of the joint surfaces
- Many of these joints contain a bursa, which is a fluid sac that provides lubrication to enhance joint mobility.
Tendons and Ligaments

- Tendons are structures that connect the muscles to the bone
- Ligaments are structures that connect bones to other bones
Muscles

- **Cardiac muscle**
  - Located only in the heart; responsible for the pumping action of the heart that maintains the blood circulation

- **Smooth muscle**
  - Found in the walls of hollow organs, such as the blood vessels, stomach, intestines, and urinary bladder

- **Skeletal muscle**
  - The largest amount of muscle tissue in the body
  - Major function is to move the bones of the skeleton
Expected Age-Related Changes

- Decreased bone calcium
- Decreased fluid in intravertebral disks
- Decreased blood supply to muscles
- Decreased tissue elasticity
- Decreased muscle mass
Common Disorders Seen with Aging

- Osteoporosis
- Degenerative joint disease
  - Osteoarthritis
  - Rheumatoid arthritis
  - Bursitis
  - Gouty arthritis
Audience Response System

Question 1

- The organ that produces calcitonin is:
  - parathyroid.
  - pituitary.
  - adrenal.
  - thyroid.
  - liver.
The Respiratory System
Upper Respiratory System

- Includes the air passages of the nose, mouth, and throat, all of which are located above the chest cavity.
- The nasopharynx is connected to the middle ear by the eustachian tubes, which help maintain proper air pressure in the middle ear.
- The larynx, or voice box, is composed of cartilage rings and folds of tissue called *vocal folds*.
- The epiglottis prevents food from entering the airway.
Lower Respiratory Tract

• Includes the lower trachea, bronchial passages, and alveoli, all of which lie within the chest cavity
  • The trachea is a cartilaginous passageway that connects the larynx to the bronchial passages of the lungs.
  • It branches into two major bronchi, which further divide like the branches of a tree into smaller and smaller bronchioles.
  • At the ends of the bronchioles are the alveoli, or air sacs, which are the functional units of respiration.
Air Exchange (Respiration)

• Ventilation
• The movement of air into and out of the alveoli
• Requires the action of muscles, primarily the diaphragm and the intercostal muscles
Air Exchange (Respiration) (Cont.)

• Inhalation or inspiration
  • The diaphragm contracts and moves downward while the intercostal muscles pull the ribs upward and outward
  • These combined activities increase the size of the chest cavity until the air pressure inside the lungs is lower than the atmospheric pressure and air is drawn into the lungs
Air Exchange (Respiration) (Cont.)

- Exhalation or expiration
  - When the diaphragm and intercostal muscles relax, the diaphragm moves upward and the ribs move inward, making the chest cavity smaller
  - As the chest cavity becomes smaller, the pressure in the lungs becomes greater than the atmospheric pressure
  - Air is forced out of the lungs until the pressure in the lungs equals the atmospheric pressure
Expected Age-Related Changes

- Decreased body fluids
- Decreased number of cilia
- Decreased number of macrophages
- Decreased tissue elasticity in the alveoli and lower lung
- Decreased muscle strength and endurance
- Decreased number of capillaries
- Increased calcification of cartilage
Common Disorders Seen with Aging

- Chronic obstructive pulmonary disease
  - Asthma, emphysema, and chronic bronchitis
- Influenza
- Pneumonia
- Tuberculosis
- Lung cancer
The various forms of influenza, such as the Hong Kong or Beijing flu, are often named for the physician who first discovered the disease.

A. True
B. False
The Cardiovascular System
Heart

• A muscular organ located centrally in the thoracic cavity between the lungs

• The heart, which is composed of cardiac muscle (called myocardium), is a hollow organ with four distinct chambers
  • Right atrium and right ventricle
  • Left atrium and left ventricle
Blood Vessels

• Arteries
  • Blood vessels that carry blood away from the heart
  • With the exception of the pulmonary artery, arteries carry oxygenated blood
Blood Vessels (Cont.)

• Veins
  • Vessels that carry blood toward the heart
  • With the exception of the pulmonary vein, veins carry deoxygenated blood
Conduction System

- The heart’s rhythm is established by specialized cells within the heart muscle that make up the electrical system
  - Sinoatrial node
  - Atrioventricular node
  - Bundle of His
  - Right and left bundle branches
  - Purkinje fibers
Audience Response System
Question 3

• The body’s natural pacemaker is the:
  • atrioventricular node.
  • Purkinje fibers.
  • sinoatrial node.
  • bundle of His.
Expected Age-Related Changes

• Decreased cardiac muscle tone
• Increased heart size, left ventricular
• Decreased cardiac output
• Decreased elasticity of heart muscle and blood vessels
• Decreased pacemaker cells
• Decreased baroreceptor sensitivity
• Increased incidence of valvular sclerosis
• Increased atherosclerosis
Common Disorders Seen With Aging

- Coronary artery disease
- Coronary valve disease
- Cardiac arrhythmias
- Congestive heart failure
- Cardiomegaly
Common Disorders Seen With Aging (Cont.)

- Peripheral vascular disease
- Occlusive peripheral vascular problems
- Varicose veins
- Aneurysm
- Hypertensive disease
The Hematopoietic and Lymphatic Systems
Blood

• Flows within the heart and vessels of the cardiovascular system
• General functions
  • Transportation of nutrients, waste products, blood gases, and hormones
  • Regulation of fluid-electrolyte balance, acid-base balance, and body temperature
  • Protection against pathogenic attack by WBCs and against excessive blood loss through clotting mechanisms
Blood (Cont.)

- Erythrocytes
  - Red blood cells
- Leukocytes
  - White blood cells
- Thrombocytes
  - Platelets
Lymph System

• Lymph vessels, fluid, and nodes
  • These permeable vessels absorb fluid and proteins from the tissues
  • Fluid moves through a series of lymph nodes and nodules that trap and phagocytize foreign materials before the fluid enters the circulatory system at the subclavian veins
Lymph System (Cont.)

- Spleen and thymus
  - The spleen is responsible for producing lymphocytes and monocytes, which enter the bloodstream
  - It also contains fixed plasma cells, which produce antibodies to foreign antigens, and fixed macrophages
  - The embryonic bone marrow and the spleen produce the initial T lymphocytes
Lymph System (Cont.)

- Lymphocytes and immunity
  - B lymphocytes are responsible for the recognition of antigens located on a foreign cell and for humoral immunity
  - Sensitized helper T cells detect antigens and induce B cells to produce antibodies, which are then found in the globulin portion of plasma
Expected Age-Related Changes

- Increased plasma viscosity
- Decreased red blood cell production
- Decreased mobilization of neutrophils
- Increased immature T-cell response
Common Disorders Seen With Aging

- Anemia
  - Inadequate levels of RBCs or insufficient hemoglobin
- Leukemia
  - The result of excessive production of immature WBCs
The most abundant plasma protein that is important in maintenance of osmotic pressure is:

A. amino acid.
B. sodium.
C. lipids.
D. glucose.
E. albumin.
The Gastrointestinal System
Oral Cavity

• Food normally enters the body through the mouth and is prepared for digestion in the oral cavity
• The teeth mechanically process food by biting, tearing, grinding, and chewing it
• The normal adult has 28 to 32 permanent teeth, with shapes and sizes that vary depending on their function
Tongue

• A highly flexible structure controlled by and composed primarily of skeletal muscle
• Papillae, which contain the taste buds, are located on the upper surface of the tongue
• Cranial nerves control the movement of the tongue and carry the impulses for the perception of taste
• The tongue aids in mechanical digestion by positioning food between the teeth and mixing it with saliva in the oral cavity
Salivary Glands

• Excrete saliva into the oral cavity
• Saliva is composed primarily of water but also contains the enzyme amylase, which begins the digestion of starch
• When adequately mixed with saliva, food reaches a consistency that makes it more suitable for chemical digestion
Stomach

• A muscular sac in which both mechanical and chemical digestion take place
• Lined with mucous membrane, which helps prevent damage to the muscle walls
• Special stomach glands secrete mucus; others secrete enzymes, intrinsic factor, and hydrochloric acid
Stomach (Cont.)

• Once the food has been processed in the stomach, it is referred to as *chyme*

• After adequate mixing, small amounts of chyme are released through the pyloric sphincter into the small intestine
Small Intestine

• More than 20 feet long; divided into three segments called the *duodenum, jejunum, and ileum*

• Additional substances are added to chyme in the small intestine to complete digestion
  • Intestinal juice, bile, and pancreatic juice

• Absorption of nutrients occurs primarily in the small intestine
Large Intestine

• Approximately 5 feet long; divided into segments called the *ascending, transverse, descending, and sigmoid colons* and the *rectum*

• Major functions
  • Absorption of water, minerals, and vitamins
  • Storage and elimination of indigestible wastes
Large Intestine (Cont.)

• When peristalsis causes the waste product to enter the rectum, its presence there triggers the defecation reflex, in which strong peristaltic movements propel the mass from the rectum and through the anus.
Expected Age-Related Changes

- Increased dental caries and tooth loss
- Decreased thirst perception
- Decreased gag reflex
- Decreased muscle tone at sphincters
- Decreased saliva and gastric secretions
- Decreased gastric motility and peristalsis
- Decreased liver size and enzyme production
Common Disorders Seen with Aging

• Hiatal hernia
• Gastritis and ulcers
• Diverticulosis and diverticulitis
• Cancer
• Hemorrhoids
• Rectal prolapse
The Urinary System
Kidneys

- Two bean-shaped organs located on each side of the spine behind the peritoneal lining of the abdomen and at the lower edge of the rib cage
- Within each kidney is a maze of nearly a million nephrons, the functional portion of the kidney
Kidneys (Cont.)

- Blood is filtered in the glomerulus of the nephron; this filtrate is destined to become urine
- The kidneys play an important role in fluid and electrolyte balance and acid-base balance in the body
- Help regulate blood pressure
Ureters and Bladder

- The ureters are tubes of smooth muscle that allow urine to drain from each kidney into the bladder.
- The bladder is a hollow muscular sac located below the peritoneum and normally entirely within the pelvic cavity.
Ureters and Bladder (Cont.)

• The muscular wall of the bladder is lined with a mucous membrane capable of stretching to hold large volumes of urine (up to 1000 mL or more)
• The urethra is a tube-like passage that leads from the bladder to the outside of the body
Characteristics of Urine

- Urine is approximately 95% water, with the remainder composed of waste products and salts
- A specific gravity of 1.010 to 1.025 is considered normal
- Urine is normally clear, and its color ranges from pale yellow to dark amber
- May be alkaline or acidic, depending on the diet of the individual
Expected Age-Related Changes

- Decreased number of functional nephrons
- Decreased blood supply
- Decreased muscle tone
- Decreased tissue elasticity
- Delayed or decreased perception of need to void
- Increased nocturnal urine production
- Increased size of prostate (male)
Common Disorders Seen with Aging

- Urinary incontinence
- Urinary tract infection
- Chronic renal failure
The Nervous System
Central Nervous System

- Medulla
  - Controls many vital functions, including heart rate, constriction of blood vessels, and respiration
- Pons and midbrain
  - The pons works with the medulla to regulate breathing rhythm
  - The midbrain integrates visual and auditory reflexes and helps maintain balance and equilibrium
Central Nervous System (Cont.)

• Cerebellum
  • Works to coordinate body movement at an unconscious level
• Hypothalamus
  • The coordinating center for the autonomic nervous system
• Cerebrum
  • The largest part of the human brain
Peripheral Nervous System

- Consists of the cranial and the spinal nerves
- A relay system that detects changes in both the internal and external environments; relays this information to the central nervous system
- Transmits impulses from the brain and spinal cord to the appropriate end-organs
- Probably because of the myelin sheath, injured peripheral nerves can be surgically repaired or may even regenerate spontaneously if the damage is not too severe
Expected Age-Related Changes

- Decreased number of brain cells
- Decreased number of nerve fibers
- Decreased amounts of neuroreceptors
- Decreased peripheral nerve function
Common Disorders Seen with Aging

- Parkinson’s disease
- Dementia
- Alzheimer’s disease
- Transient ischemic attack
- Cerebrovascular accident
The most common form of dementia is:
A. Alzheimer’s disease.
B. vascular dementia.
C. dementia with Lewy bodies.
D. frontotemporal dementia
The Special Senses
The Eyes

• Two globe-shaped structures located in the orbits of the skull on each side of the nose
• Composed of three layers
  • Sclera
  • Choroid
  • Retina
• The greatest part of the eye mass is made up of two fluid-filled cavities, anterior chamber and posterior chamber
Expected Age-Related Changes

• Decreased number of eyelashes
• Decreased tear production
• Increased discoloration of lens
• Decreased tissue elasticity
• Decreased muscle tone
Common Disorders Seen with Aging

- Blepharitis
- Diplopia
- Cataracts
- Glaucoma
- Age-related macular degeneration and retinal detachment
The Ears

• The ear is composed of three distinct portions: outer ear, middle ear, and inner ear
• The two main functions of the ear are the detection of sound and maintenance of balance
Expected Age-Related Changes

- Decreased tissue elasticity
- Decreased joint mobility
- Decreased ceruminous cells in the external ear canal
- Atrophy of vestibular structures and structures in the inner ear
Common Disorders Seen with Aging

- Otosclerosis
- Tinnitus
- Deafness
- Ménière’s disease
Taste and Smell

• The receptors for our sense of taste are located in the papillae, or taste buds, on the superior surface of the tongue
  • In these papillae are chemical receptor cells sensitive to salty, sweet, sour, or bitter chemicals
Taste and Smell (Cont.)

- The detection of odors occurs when the olfactory receptors in the upper nasal cavities respond to airborne chemicals.
  - When vapors escape from food or other volatile substances, they enter the nose and stimulate the receptors.
Expected Age-Related Changes

- Decreased number of papillae on tongue
- Decreased number of nasal sensory receptors
The Endocrine System
Pituitary Gland

• Often referred to as the master gland of the body because of the many functions it regulates
• There are two major segments of the pituitary gland, the anterior pituitary and the posterior pituitary
Thyroid Gland

• Surrounds the trachea and is located just below the larynx (voice box)
• The major hormones produced by the thyroid gland are thyroxin, triiodothyronine, and calcitonin
Parathyroid Glands

- Located on the posterior surface of the lobes of the thyroid gland
- Parathyroid hormone, an antagonist of calcitonin, stimulates the movement of calcium and phosphorus from the bones into the blood
Pancreas

• Functions as an exocrine gland in digestion
• Endocrine secretions are produced by A cells and B cells in the islets of Langerhans
  • The A cells produce glucagon, which stimulates the liver to convert glycogen to glucose
  • The B cells produce insulin, which increases the permeability of cell membranes and enables the cells to use glucose, amino acids, and fatty acids
Adrenal Glands

- Located on the top of each kidney
  - Adrenal medulla secretes epinephrine and norepinephrine
  - Adrenal cortex releases mineralocorticoids, glucocorticoids, and small amounts of sex hormones
Ovaries and Testes

• Secrete the hormones involved in sexual maturation and function
• The primary hormones secreted by the ovaries are estrogen and progesterone
• The testes secrete the major male sex hormone, testosterone, which is responsible for maturation of sperm and for development of the secondary male sexual characteristics
Expected Age-Related Changes

• Decreased pituitary secretions (growth hormone)
• Decreased production of thyroid-stimulating hormone
• Decreased insulin production or increased insulin resistance
• Decreased production of parathyroid hormone
Common Disorders Seen with Aging

- Diabetes mellitus
  - Type 1 and type 2
- Hypoglycemia
- Hypothyroidism
According to the American Diabetes Association, in 2011 the percentage of people over 65 years of age who had diabetes mellitus was:

A. 12%.
B. 27%.
C. 38%.
D. 51%.
E. 88%.
The Reproductive and Genitourinary Systems
Female Reproductive Organs

• The primary female sexual organs include the ovaries, fallopian tubes, uterus, and vagina
• Located in the pelvic cavity between the bladder and the bowels
• When a woman reaches menopause (some time between 45 and 60 years of age), the hormonal function of the ovaries decreases and then ceases
Male Reproductive Organs

• The male organs of reproduction consist of the testes, a series of ducts and glands, and the penis, which contains the passageway by which sperm, the male sex cells, leave the body in the ejaculate
• The testes are suspended in a tissue sac called the scrotum, which hangs between the thighs
• The prostate gland is located just below the urinary bladder
Expected Age-Related Changes

- Changes in women
  - Decreased estrogen levels
  - Decreased tissue elasticity
- Changes in men
  - Decreased testosterone levels
  - Decreased circulation
Common Disorders Seen with Aging

- Uterine prolapse
- Vaginal infection
- Breast cancer
- Prostate cancer