Chapter 24
Soft-Tissue Injuries

Unit Summary

After students complete this chapter and the related course work, they will have an understanding of types of open and closed soft-tissue injuries, how to care for soft-tissue injuries, including the use of dressings and bandages, the assessment and care of different types of burns including thermal, chemical, and electrical burns.

National EMS Education Standard Competencies

Trauma

Applies fundamental knowledge to provide basic emergency care and transportation based on assessment findings for an acutely injured patient.

Soft-Tissue Trauma

Recognition and management of:

ÅWounds (pp 806ï 822)

ÅBurns

- ÅElectrical (pp 822ï 825, 826ï 828, 831ï 836)
- ÅChemical (pp 822ï 826, 831ï 836)
- ÅThermal (pp 822ï 825, 828ï 829, 831ï 836)

ÅChemicals in the eye and on the skin (pp 822ï 826, 831ï 836)

Pathophysiology, assessment, and management of:

ÅWounds

- ÅAvulsions (pp 806ï 807, 809ï 819)
- ÅBite wounds (pp 806ï 807, 821ï 822)
- ÅLacerations (pp 806ï 807, 809ï 819)
- ÅPuncture wounds (pp 806ï 807, 809ï 819)
- ÅIncisions (pp 806ï 807, 809ï 819)

ÅBurns

- ÅElectrical (pp 806ï 807, 822ï 825, 826ï 828, 831ï 836)
- ÅChemical (pp 806ï 807, 822ï 826, 831ï 836)
- ÅThermal (pp 806ï 807, 822ï 825, 828ï 829, 831ï 836)
- ÅRadiation (pp 806ï 807, 822ï 825, 830ï 836)

ÅCrush syndrome (pp 806ï 808, 811ï 817)

Knowledge Objectives

1. Discuss the anatomy of the skin, including the layers of the skin. (pp 805ï 806)
2. Understand the functions of the skin. (p 806)
3. Describe the three types of soft-tissue injuries. (pp 806ï 807)
4. Describe the types of closed soft-tissue injuries. (pp 808ï 809)
5. Describe the types of open soft-tissue injuries. (pp 809ï 811)
6. Discuss the assessment of both closed and open injuries. (pp 811ï 817)
7. Describe the relationship between airway management and the patient with closed and open injuries. (pp 813ï 814)
8. Describe the emergency medical care for closed and open injuries. (pp 817ï 822)
9. Explain the emergency medical care for a patient with an open wound to the abdomen. (p 819)
10. Discuss the emergency medical care for a patient with an impaled object. (pp 820ï 821)
11. Discuss the emergency medical care for neck injuries. (p 821)
12. Discuss the management of small animal bites, human bites, and rabies. (pp 821ï 822)
13. Explain how the seriousness of a burn is related to its depth and extent. (pp 822ï 825)
14. Define and give the characteristics of superficial, partial-thickness, and full-thickness burns. (p 824)
15. Describe and discuss the emergency management of chemical, electrical, thermal, inhalation, and radiation burns. (pp 825ï 831)
16. Explain the steps involved in the assessment of burns. (pp 831ï 834)
17. Describe the emergency medical care for burn injuries. (pp 825ï 831, 834ï 836)
18. Understand the functions of sterile dressings and bandages. (pp 836ï 837)

Skills Objectives

1. Demonstrate the emergency medical care of closed soft-tissue injuries. (p 817)
2. Demonstrate the emergency medical care of a patient with an open chest wound. (pp 817ï 819)
3. Demonstrate how to control bleeding from an open soft-tissue injury. (pp 817ï 819, Skill Drill 24-1)
4. Demonstrate the emergency medical care of a patient with an open abdominal wound. (p 819)
5. Demonstrate how to stabilize an impaled object. (pp 820ï 821, Skill Drill 24-2)
6. Demonstrate how to care for a burn. (pp 834ï 836, Skill Drill 24-3)
7. Demonstrate the emergency medical care of a patient with a chemical, electrical, thermal, inhalation, or radiation burn. (pp 825ï 831, 834ï 836)

Lecture

I. Introduction

A. Soft-tissue injuries are common.

1. They can be as simple as a cut or scrape.
2. They can be as serious as a life-threatening internal injury.
3. Do not be distracted by dramatic open wounds.
    a. Do not make the mistake of neglecting other life-threatening conditions such as airway obstructions.

B. The soft tissues of the body can be injured through a variety of mechanisms.

1. A blunt injury occurs when the energy exchange between the patient and an object is more than the tissues can tolerate.
2. A penetrating injury occurs when an object breaks through the skin and enters the body.
3. Barotrauma injuries occur from sudden or extreme changes in air pressure.
4. Burns may also result in soft-tissue injuries.

C. Soft-tissue trauma is the leading form of injury.

1. Open wounds account for approximately 6.5 million emergency department visits annually.
2. Nearly 5 million patients present with contusions (bruises).

D. Death is often related to hemorrhage or infection.

1. Uncontrolled hemorrhage can lead to shock and death.
2. When the skin barrier is breached, invading pathogens can cause local or systemic infection.

E. EMTs can teach children and others preventive actions.

II. The Anatomy and Physiology of the Skin

A. The skin is our first line of defense against external forces and infections.

1. It is the largest organ in the body.
2. It is relatively tough, but still susceptible to injury.
    a. Injuries range from simple bruises and abrasions to serious lacerations and amputations.
    b. Injuries may expose blood vessels, nerves, and bones.

B. In all instances, you must:

1. Control bleeding.
2. Prevent further contamination to decrease the risk of infection.
3. Protect wounds from further damage.
4. Apply dressings and bandages to various parts of the body.

C. Skin varies in thickness, depending on the person's age and the skin's location.

1. Skin is thinner in the very young and the very old.
2. Skin is thinner on the eyelids, lips, and ears than on the scalp, back, and soles of the feet.
3. Thin skin is more easily damaged than thick skin.

D. Anatomy

1. The skin has two principal layers: the epidermis and dermis.
    a. The epidermis is the tough, external layer that forms a watertight covering for the body.
        i. The epidermis is itself composed of several layers.
    b. The dermis is the inner layer of the skin.
        i. It contains the hair follicles, sweat glands, and sebaceous glands.

ii. Blood vessels in the dermis provide the skin with nutrients and oxygen.

2. Skin covers all the external surfaces of the body.
   a. The various openings in the body are lined with mucous membranes.
      i. Mucous membranes provide a protective barrier against bacterial invasion.
      ii. Mucous membranes secrete a watery substance that lubricates the openings.
      iii. Mucous membranes are moist, whereas skin is dry.

E. Physiology

1. Skin serves many functions.
   a. Keeps pathogens out
   b. Keeps water in
   c. Assists in temperature regulation
   d. The nerves in the skin report to the brain on the environment and many sensations.
2. Any break in the skin allows bacteria to enter and raises the possibilities of infection, fluid loss, and loss of temperature control.
   a. Any one of these problems can cause serious illness and even death.

III. Pathophysiology

A. There are three types of soft-tissue injuries:

1. Closed injuries
   a. Damage occurs beneath the skin or mucous membrane.
   b. Surface of the skin remains intact.
2. Open injuries
   a. There is a break in the surface of the skin or mucous membrane.
   b. Exposes deeper tissues to contamination
3. Burns
   a. Damage results from:
      i. Thermal heat
      ii. Frictional heat
      iii. Chemicals
      iv. Electricity
      v. Nuclear radiation

B. Pathophysiology of closed and open injuries

1. Healing of wounds is a natural process that involves several overlapping stages, all directed toward the larger goal of maintaining homeostasis.
2. Cessation of bleeding is the primary concern.
   a. Loss of blood hinders the provision of vital nutrients and oxygen to the affected area.
   b. It also impairs the tissueôs ability to eliminate wastes.
   c. The end result is abnormal or absent function, which interferes with homeostasis.
3. The next wound healing stage is inflammation.
   a. Additional cells move into the damaged area to begin repair.
   b. White blood cells migrate to the area to combat pathogens that have invaded exposed tissue.
   c. Lymphocytes destroy bacteria and other pathogens.

d. Mast cells release histamine.
e. Inflammation ultimately leads to the removal of:
    i. Foreign material
    ii. Damaged cellular parts
    iii. Invading microorganisms

4. To replace the area damaged in a soft-tissue injury, a new layer of cells must be moved into this region.
    a. Cells quickly multiply and redevelop across the edges of the wound.
    b. Except in cases of clean incisions, the appearance of the restructured area seldom returns to the preinjury state.
    c. Despite the changed appearance, the function of the area may be restored to near normal.
5. New blood vessels form as the body attempts to bring oxygen and nutrients to the injured tissue.
    a. New capillaries bud from intact capillaries that lie adjacent to the damaged skin.
    b. These vessels provide a conduit for oxygen and nutrients and serve as a pathway for waste removal.
6. In the last stage of wound healing, collagen provides stability to the damaged tissue and joins wound borders, thereby closing the open tissue.
    a. Collagen is a tough, fibrous protein found in scar tissue, hair, bones, and connective tissue.
    b. Unfortunately, collagen cannot restore the damaged tissue to its original strength.

C. Pathophysiology of burns

1. Burns are diffuse soft-tissue injuries created by destructive energy transfer via radiation, thermal, or electrical energy.
    a. Thermal burns can occur when skin is exposed to temperatures higher than 111°F (44°C).
    b. The severity of a thermal injury correlates directly with:
        i. Temperature
        ii. Concentration
        iii. Amount of heat energy possessed by the object or substance
        iv. Duration of exposure
    c. The greater the heat energy, the deeper the wound.
2. Exposure time is another important factor.
3. People reflexively limit heat energy and exposure time.
    a. If clothing is on fire or the person is trapped or unconscious, exposure time will be longer.

IV. Closed and Open Injuries

A. Closed injuries

1. Closed soft-tissue injuries are characterized by:
    a. History of blunt trauma
    b. Pain at the site of injury
    c. Swelling beneath the skin
    d. Discoloration
2. A contusion (bruise) is an injury that causes bleeding beneath the skin but does not break the skin.
    a. Contusions result from blunt forces striking the body.
    b. The epidermis remains intact, but cells within the dermis are damaged, and small blood vessels are usually torn.

c. The buildup of blood produces a characteristic blue or black discoloration called ecchymosis.

3. A hematoma is blood that is collected within damaged tissue or in a body cavity.
   a. It occurs whenever a large blood vessel is damaged and bleeds rapidly.
   b. It is usually associated with extensive tissue damage.
4. A crushing injury occurs when a great amount of force is applied to the body.
   a. The extent of the damage depends on:
      i. How much force is applied
      ii. Amount of time that the force is applied
   b. Continued compression of the soft tissues will cut off circulation, producing further tissue destruction.
5. When an area of the body is trapped for longer than 4 hours and arterial blood flow is compromised, crush syndrome can develop.
   a. Crush syndrome is significant metabolic derangement that can lead to renal failure and death.
6. Compartment syndrome results from the swelling that occurs whenever tissues are injured.
   a. The cells that are injured leak watery fluid into the spaces between the cells.
   b. The pressure of the fluid may become great enough to compress the tissue and cause further damage.
   c. The hallmark sign is pain out of proportion to the injury.
7. Severe closed injuries can also damage internal organs.
   a. The greater the amount of energy absorbed from the blunt force, the greater the risk of injury to deeper structures.
   b. You must assess all patients with closed injuries for more serious hidden injuries.

B. Open injuries

1. Open injuries differ from closed injuries in that the protective layer of the skin is damaged.
   a. This can produce extensive bleeding.
2. A break in the protective skin layer or mucous membrane means that the wound is contaminated and may become infected.
   a. Contamination describes the presence of infectious organisms or foreign bodies, such as dirt, gravel, or metal, in the wound.
   b. You must address excessive bleeding and contamination in your treatment of open soft-tissue wounds.
   c. There are four types of open soft-tissue wounds:
      i. Abrasions
      ii. Lacerations
      iii. Avulsions
      iv. Penetrating wounds
3. An abrasion is a wound of the superficial layer of the skin, caused by friction when a body part rubs or scrapes across a rough or hard surface.
   a. An abrasion usually does not penetrate completely through the dermis, but blood may ooze from the injured capillaries in the dermis.
   b. Examples: road rash, road burn, strawberry, rug burn
4. A laceration is a jagged cut caused by a sharp object or a blunt force that tears the tissue.
   a. An incision is a sharp, smooth cut.
   b. The depth of the injury can vary.
   c. Lacerations and incisions may appear linear (regular) or stellate (irregular).
   d. Lacerations or incisions that involve arteries or large veins may result in severe bleeding.

5. An avulsion separates various layers of soft tissue (usually between the subcutaneous layer and fascia) so that they become either completely detached or hang as a flap.
    a. Often there is significant bleeding.
    b. Never remove an avulsion skin flap, regardless of its size.
    c. An amputation is an injury in which part of the body is completely severed.
        i. You can easily control the bleeding from some amputations, such as the fingers, with direct pressure and pressure dressings.
        ii. If there is massive bleeding, you will need to treat the patient for hypovolemic shock.
6. A penetrating wound is an injury resulting from a sharp, pointed object, such as a knife, ice pick, splinter, or bullet.
    a. These objects can damage structures deep within the body and cause unseen bleeding.
    b. If the wound is to the chest or abdomen, the injury can cause rapid, fatal bleeding.
7. Stabbings and shootings often result in multiple penetrating injuries.
    a. Assess the patient carefully to identify all wounds.
    b. Count the number of penetrating injuries, especially with gunshot wounds.
        i. Leave the distinction between entrance and exit to the physician.
    c. In a shooting, determine the type of gun and rounds fired, and document your care.
    d. You may have to testify in court.
8. Blast injuries also may often result in multiple penetrating injuries.
    a. Primary blast injury
        i. Damage is caused by the pressure of the explosion.
    b. Secondary blast injury
        i. Damage results from flying debris.
    c. Tertiary blast injury
        i. The victim is thrown by the explosion, perhaps into an object.

V. Patient Assessment of Closed and Open Injuries

A. It is more difficult to assess a closed injury than to assess an open injury.

1. Anytime you observe bruising, swelling, or deformity, or the patient is reporting pain, the possibility of a closed injury should be considered.
2. An open injury is easier to assess because you can see the injury.

B. Scene size-up

1. Scene safety
    a. Observe the scene for hazards to yourself, your crew, and the patient.
    b. Assess for the potential for violence.
    c. Assess for environmental hazards.
    d. Take standard precautions to minimize your direct exposure to body fluids.
    e. Determine the number of patients.
    f. Consider if you need additional or specialized resources.
2. Mechanism of injury (MOI)/nature of illness (NOI)
    a. Look for indicators of the MOI as you assess the scene.
    b. The MOI may provide indicators of safety threats.
        i. If the scene is unsafe, request additional help early.

C. Primary assessment

1. Focus on identifying and managing life-threatening concerns.
2. Perform a rapid scan of the patient.
3. Providing high-flow oxygen to patients with closed soft-tissue injuries may help reduce the effects of shock and assist in perfusion of damaged tissues.
4. Do not delay transport of a seriously injured trauma patient to complete nonlifesaving treatments in the field.
5. If you discover an open injury with significant bleeding, cover the wound and control the bleeding as quickly as possible.
6. Form a general impression.
    a. Important indicators will alert you to the seriousness of the patientôs condition.
        i. Is the patient awake and interacting with his or her surroundings, or is the patient lying still, making no sounds?
        ii. Does the patient have any apparent life threats?
        iii. What color is the patientôs skin?
        iv. Is he or she responding to you appropriately or inappropriately?
    b. Trauma patients with closed soft-tissue injuries may have what appear to be minor injuries.
        i. Do not be distracted from looking for more serious hidden injuries.
    c. Check for responsiveness using the AVPU scale.
7. Airway and breathing
    a. Ensure that the patient has a clear and patent airway.
    b. Because trauma was involved, protect the patient from further spinal injury by preventing the head and torso from moving.
    c. Assess the patient for adequate breathing.
    d. Inspect and palpate the chest wall for DCAP-BTLS.
    e. Open soft-tissue injuries of the face and neck have a potential to interfere with the effectiveness of the airway and breathing.
        i. Evaluate the patientôs voice and speaking ability.
8. Circulation
    a. Quickly assess the patientôs pulse rate and quality.
    b. Determine the skin condition, color, and temperature.
    c. Check the capillary refill time.
    d. Your assessment of the pulse and skin will give you an indication as to how aggressively you need to treat your patient for shock.
    e. If visible significant bleeding is seen, you must begin the steps necessary to control bleeding.
9. Transport decision
    a. Types of patients that need immediate transportation:
        i. Poor initial general impression
        ii. Altered level of consciousness
        iii. Dyspnea
        iv. Abnormal vital signs
        v. Shock
        vi. Severe pain
    b. Patients who have visible significant bleeding or signs of significant internal bleeding may quickly become unstable.

D. History taking

1. Investigate the chief complaint.
   a. Obtain a medical history and be alert for injury-specific signs and symptoms and any pertinent negatives.
   b. Obtain a SAMPLE history from your patient.
      i. Using OPQRST may provide some background on isolated extremity injuries.
      ii. Any information you receive will be very valuable if the patient loses consciousness.
   c. If the patient is unresponsive, attempt to obtain the history from other sources:
      i. Friends or family members
      ii. Bystanders
      iii. Medical identification jewelry
      iv. Cards in wallets
   d. Typical signs of an open injury include:
      i. Bleeding
      ii. Break(s) in the skin
      iii. Shock
      iv. Hemorrhage
      v. Disfigurement or loss of a body part
   e. Conditions such as anemia and hemophilia can complicate open soft-tissue injuries.

E. Secondary assessment

1. The secondary assessment is a more systematic head-to-toe or focused examination of the patient.
2. Physical examinations
   a. Look, listen, and feel for signs of airway problems.
   b. Ask yourself the following questions:
      i. Is the patient in a tripod position?
      ii. What is the skinôs color and condition?
      iii. Are there any signs of increased respiratory efforts such as retractions, nasal flaring, pursed lip breathing, or use of accessory muscles?
   c. Listen for air movement and breath sounds.
   d. Assess pulse rate and quality.
   e. Determine the skin condition, color, and temperature.
   f. Check the capillary refill time.
   g. Assess the neurologic system, including:
      i. Level of consciousness
      ii. Pupil size and reactivity
      iii. Motor response
      iv. Sensory response
   h. Assess the musculoskeletal system with a detailed full-body scan.
   i. Assess all anatomic regions, looking for the following signs/symptoms:
      i. Raccoon eyes, Battleôs sign, and/or drainage of blood or fluid from the ears or nose
      ii. Jugular vein distention and tracheal deviation
      iii. Check the pelvis for stability.
      iv. Check the abdomen.
      v. Check the extremities, and record pulse, motor, and sensory function.
2. Vital signs

a. It is important to reassess the vital signs to identify how quickly the patientôs condition is changing.
b. Use appropriate monitoring devices to quantify:
    i. Oxygenation
    ii. Circulatory status
    iii. Blood pressure

F. Reassessment

1. Repeat the primary assessment.
2. Reassess vital signs and the chief complaint.
3. Recheck patient interventions.
4. Assess all bandaging frequently.
5. Identify and treat changes in the patientôs condition.
6. Interventions
    a. Assess and manage all threats to the patientôs airway, breathing, and circulation.
    b. All patients with a closed injury should receive oxygen via a nonrebreathing mask.
    c. Expose all wounds, cleanse the wound surface, control bleeding, and be prepared to treat the patient for shock.
    d. Extremities that are painful, swollen, or deformed should be splinted.
7. Communication and documentation
    a. Your documentation must include a description of the MOI and the position in which you found the patient when you arrived on scene.
    b. It is important to recognize, estimate, and report the amount of blood loss and how rapidly or how much time has passed since the bleeding started.
    c. Include the location and description of any soft-tissue injuries or other wounds you have located and treated.
    d. Describe the size and depth of the injury.
    e. Provide an accurate account of how you treated these injuries.

VI. Emergency Medical Care for Closed Injuries

A. Small contusions require no special emergency medical care.

B. More extensive closed injuries may involve significant swelling and bleeding beneath the skin, which could lead to hypovolemic shock.

C. Soft-tissue injuries may look rather dramatic.

1. You must still focus on the airway and breathing first.
2. If the patient has inadequate breathing, you may have to assist ventilations with a bag-mask device.
3. Treat a closed soft-tissue injury using the RICES mnemonic:
    a. Rest
    b. Ice
    c. Compression
    d. Elevation
    e. Splinting
4. You should also be alert for signs of developing shock, including:
    a. Anxiety or agitation
    b. Changes in mental status

c. Increased heart rate
d. Increased respiratory rate
e. Diaphoresis
f. Cool or clammy skin
g. Decreased blood pressure

5. If the patient appears to be in shock, you should place the patient in a position of comfort and provide supplemental high-flow oxygen and prompt transport.

VII. Emergency Medical Care for Open Injuries

A. Before you begin to care for a patient with an open wound, follow standard precautions.

1. Wear gloves, eye protection, and, if necessary, a gown and a mask.
2. Make sure that the airway is open, and administer high-flow oxygen.
3. Control life-threatening bleeding using:
   a. Direct, even pressure and elevation
   b. Pressure dressings and/or splints
   c. Tourniquets
4. Follow the steps in ***Skill Drill 24-1*** to control bleeding from an extremity.

B. All open wounds are assumed to be contaminated and present a risk of infection.

1. By applying a sterile dressing, you are reducing the risk of further contamination.
2. You should not try to remove material from an open wound, no matter how dirty the wound is.

C. Often, you can better control bleeding from open soft-tissue wounds by splinting the extremity, even if there is no fracture.

D. Abdominal wounds

1. An open wound in the abdominal cavity may expose internal organs.
2. In some cases, the organs may even protrude through the wound, an injury called an evisceration.
   a. Cover the wound with sterile gauze moistened with sterile saline solution.
   b. Secure with an occlusive dressing.
   c. Keep the organs moist and warm.
3. Most patients with abdominal wounds require immediate transport to a trauma center.

E. Impaled objects

1. Occasionally, a patient will have an object, such as a knife, fishhook, wood splinter, or piece of glass, impaled in his or her body.
2. To treat this, follow the steps in ***Skill Drill 24-2***.
3. Only remove an impaled object when the object is in the cheek and obstructs breathing, or the object is in the chest and interferes with CPR.

F. Neck injuries

1. Open neck injuries can be life threatening.
2. If the veins of the neck are open to the environment, they may suck in air.
   a. If enough air is sucked into a blood vessel, it can actually block the flow of blood in the lungs, sending the patient into cardiac arrest.
   b. This condition is called air embolism.

3. Cover the wound with an occlusive dressing.
4. Apply pressure but do not compress both carotid arteries at the same time.
    a. This could impair circulation to the brain and cause a stroke.

G. Bites

1. Small-animal bites and rabies
    a. A small animalôs mouth is heavily contaminated with virulent bacteria.
    b. You should consider all small animal bites as contaminated and potentially infected wounds that may require:
        i. Antibiotics
        ii. Tetanus prophylaxis
        iii. Suturing
    c. All small animal bites should be evaluated by a physician.
    d. A major concern is the spread of rabies, an acute, potentially fatal viral infection of the central nervous system that can affect all warm-blooded animals.
        i. The virus is in the saliva of a rabid, or infected, animal and is transmitted through biting or licking an open wound.
        ii. Infection can be prevented only by a series of special vaccine injections.
    e. Children, particularly young ones, may be seriously injured or even killed by dogs.
        i. You must assume that the animal may turn and attack you as well.
        ii. You should not enter the scene until the animal has been secured by the police or an animal control officer.
2. Human bites
    a. The human mouth contains an exceptionally wide range of virulent bacteria and viruses, more so than the small animalôs mouth.
    b. You should regard any human bite that has penetrated the skin as a very serious injury.
    c. Any laceration caused by a human tooth can result in a serious, spreading infection.
    d. Emergency treatment consists of the following steps:
        i. Apply a dry, sterile dressing.
        ii. Promptly immobilize the area with a splint or bandage.
        iii. Provide transport to the ED for surgical cleansing of the wound and antibiotic therapy.

VIII. Burns

A. Burns account for over 10,000 deaths a year.

B. Burns are among the most serious and painful of all injuries.

1. A burn occurs when the body, or a body part, receives more radiant energy than it can absorb, resulting in an injury.
    a. Potential sources of this energy include:
        i. Heat
        ii. Toxic chemicals
        iii. Electricity
2. Although a burn may be the patientôs most obvious injury, you should always perform a complete assessment to determine whether there are other serious injuries.
3. Keep in mind that children, elderly patients, and patients with chronic illnesses are more likely to experience shock from burn injuries.

C. Complications of burns

1. The skin serves as a barrier between the environment and the body.
    a. When a person is burned, this barrier is destroyed.
    b. The victim is now at a high risk for:
        i. Infection
        ii. Hypothermia
        iii. Hypovolemia
        iv. Shock
2. Burns to the airway are of significant importance because the loose mucosa in the hypopharnyx can swell and lead to complete airway obstruction.
3. Circumferential burns of the chest can compromise breathing.
4. Circumferential burns of the extremity can lead to neurovascular compromise and irreversible damage if not appropriately treated.

D. Burn severity

1. Five factors will help you determine the severity of a burn (the first two factors are the most important).
    a. What is the depth of the burn?
    b. What is the extent of the burn?
    c. Are any critical areas involved?
        i. Face, upper airway, hands, feet, genitalia
    d. Does the patient have any preexisting medical conditions or other injuries?
    e. Is the patient younger than 5 years or older than 55 years?
2. Keep in mind that burns to the face are of particular importance owning to the potential of airway involvement.
3. Burns to the hands or feet or over joints are also considered serious because of the potential for loss of function as the result of scarring.
4. Depth
    a. Superficial (first-degree) burns
        i. Involve only the top layer of skin, the epidermis
        ii. The skin turns red but does not blister or actually burn through.
        iii. The burn site is painful.
        iv. A sunburn is a good example.
    b. Partial-thickness (second-degree) burns
        i. Involve the epidermis and some portion of the dermis
        ii. These burns do not destroy the entire thickness of the skin, nor is the subcutaneous tissue injured.
        iii. Typically, the skin is moist, mottled, and white to red.
        iv. Blisters are present.
        v. Can cause intense pain
    c. Full-thickness (third-degree) burns
        i. Extend through all skin layers and may involve subcutaneous layers, muscle, bone, or internal organs
        ii. If the nerve endings have been destroyed, a severely burned area may have no feeling.
        iii. However, the surrounding, less severely burned areas may be extremely painful.
    d. Significant airway burns are also serious.

i. They may be associated with singed hair within the nostrils, soot around the nose and mouth, hoarseness, and hypoxia.

5. Extent
   a. The extent of a burn can be estimated using the rule of nines, which divides the body into sections, each representing approximately 9% of the total body surface area.
   b. The proportions differ for infants, children, and adults.

E. Chemical burns

1. Chemical burns can occur whenever a toxic substance contacts the body.
2. Most chemical burns are caused by strong acids or strong alkalis.
3. The eyes are particularly vulnerable.
4. The severity of the burn is directly related to the:
   a. Type of chemical
   b. Concentration of the chemical
   c. Duration of the exposure
5. Wear appropriate chemical-resistant gloves and eye protection whenever you are caring for a patient with a chemical burn.
6. Treatment for chemical burns can be specific to the chemical agent.
7. Management of chemical burns
   a. To stop the burning process, remove any chemical from the patient.
   b. Always brush dry chemicals off the skin and clothing before flushing the patient with water.
   c. Remove the patientôs clothing, including shoes, stockings, gloves, and any jewelry or glasses.
   d. For liquid chemicals, immediately begin to flush the burned area with large amounts of water.
   e. Continue flooding the area with gallons of water for 15 to 20 minutes after the patient says the burning pain has stopped.
   f. If the patientôs eye has been burned, hold the eyelid open while flooding the eye with a gentle stream of water.

F. Electrical burns

1. Electrical burns may be the result of contact with high- or low-voltage electricity.
   a. High-voltage burns may occur, for example, when utility workers make direct contact with power lines.
   b. Ordinary household current can cause severe burns and cardiac arrhythmias.
2. For electricity to flow, there must be a complete circuit between the electrical source and the ground.
   a. Any substance that prevents this circuit from being completed is called an insulator.
   b. Any substance that allows a current to flow through it is called a conductor.
   c. The human body is a good conductor.
   d. Thus, electrical burns occur when the body, or a part of it, completes a circuit connecting a power source to the ground.
3. The type of electric current, magnitude of current, and voltage have effects on the seriousness of burns.
4. Your safety is of particular importance when you are called to the scene of an emergency involving electricity.
   a. You can be fatally injured by coming into contact with power lines.
   b. You can be fatally injured by touching a patient who is still in contact with a live power line or any other electrical source.

c. You must never attempt to remove someone from an electrical source unless you are specially trained to do so.
d. Always assume that any downed power line is live.

5. A burn injury appears where the electricity enters and exits the body.
   a. There are two dangers specifically associated with electrical burns:
      i. There may be a large amount of deep tissue injury.
      ii. The patient may go into cardiac or respiratory arrest from the electric shock.
6. Management of electrical burns
   a. Electrical current can cross the chest and cause cardiac arrest or arrhythmias.
   b. If indicated, begin CPR on the patient and apply the automated external defibrillator (AED).
   c. You should be prepared to defibrillate if necessary.
   d. Give supplemental oxygen and monitor the patient closely for respiratory and cardiac arrest.
   e. Treat the soft-tissue injuries by applying dry, sterile dressing on all burn wounds and splinting suspected fractures.
   f. Provide prompt transport.

G. Thermal burns

1. Thermal burns are caused by heat.
2. Most commonly, they are caused by scalds or an open flame.
   a. A flame burn is very often a deep burn, especially if a personôs clothing catches fire.
   b. A scald burn is most commonly seen in children and handicapped adults but can happen to anyone, particularly while cooking.
      i. Hot liquids produce scald injuries.
      ii. Scald burns often cover large surface areas of the body because liquids can spread quickly.
3. Coming in contact with hot objects produces a contact burn.
   a. Contact burns are rarely deep unless the patient was prevented from drawing away from the hot object.
4. A steam burn can produce a topical (scald) burn.
   a. Minor steam burns are common when microwaving food covered with plastic wrap.
5. A flash burn is produced by an explosion, which may briefly expose a person to very intense heat.
   a. Lightning strikes can also cause a flash burn.
6. Management of thermal burns
   a. Stop the burning source, cool the burned area if appropriate, and remove all jewelry.
   b. Maintain a high index of suspicion for inhalation injuries.
   c. Increased exposure time will increase damage to the patient.
   d. The larger the burn, the more likely the patient will be susceptible to hypothermia and/or hypovolemia.
   e. All patients with large surface burns should have a dry dressing applied to help:
      i. Maintain body temperature
      ii. Prevent infection
      iii. Provide comfort

H. Inhalation burns

1. Inhalation injuries can occur when burning takes place in enclosed spaces without ventilation.
   a. When the upper airway is exposed to excessive heat, the patient can experience rapid and serious airway compromise.
   b. Upper airway damage is often associated with the inhalation of superheated gases.
   c. Lower airway damage is more often associated with the inhalation of chemicals and particulate matter.

2. When treating a patient for inhalation injuries, you may encounter severe upper airway swelling, requiring intervention immediately after a severe burn.
    a. Consider requesting ALS backup if the patient has signs and symptoms of edema.
3. The combustion process produces a variety of toxic gases.
    a. The less efficient the combustion process, the more toxic the gases that may be created.
4. Carbon monoxide (CO) intoxication should be considered whenever a group of people in the same place all report a headache or nausea.
5. Management of inhalation burns
    a. You must first ensure your own safety and the safety of your coworkers.
    b. Prehospital treatment of a patient with suspected hydrogen cyanide poisoning includes decontamination and supportive care.
    c. Care for any toxic gas exposure includes:
        i. Recognition
        ii. Identification
        iii. Supportive treatment

I. Radiation burns

1. Acute radiation exposure has become more than a theoretical issue because the use of radioactive materials has increased in industry and medicine.
2. Since 1944, there have been more than 400 radiation accidents involving significant radiation exposure to more than 3,000 people.
3. Potential threats include incidents related to the use and transportation of radioactive isotopes and intentionally released radioactivity in terrorist attacks.
4. You must determine if there has been a radiation exposure and then attempt to determine whether ongoing exposure continues to exist.
5. Three types of ionizing radiation:
    a. Alpha
        i. Alpha particles have little penetrating energy and are easily stopped by the skin.
    b. Beta
        i. Beta particles have greater penetrating power and can travel much farther in air than alpha particles.
        ii. They can penetrate the skin but can be blocked by simple protective clothing designed for this purpose.
    c. Gamma
        i. The threat from gamma radiation is directly proportional to its wavelength.
        ii. This type of radiation is very penetrating and easily passes through the body and solid materials
6. Most ionizing radiation accidents involve gamma radiation, or x-rays.
7. Radiation burns require special rescue techniques beyond the initial training of the EMT.
    a. Maintain a safe distance and wait for the HazMat team to decontaminate the victim before initiating patient care.
8. Management of radiation burns
    a. When patients have a radioactive source on their body, they are contaminated and must be initially cared for by a HazMat responder.
    b. Most contaminants can be removed by simply removing the patientôs clothes.
    c. Irrigate open wounds.
    d. The emergency department should be notified.
    e. Identify the radioactive source and the length of the patientôs exposure to it.

f. Limit your duration of exposure, increase your distance from the source, and attempt to place shielding between yourself and sources of gamma radiation.

IX. Patient Assessment of Burns

A. When you are assessing a burn, it is important for you to classify the victim's burns.

1. Classification of burns involves determining the:
   a. Source of the burn
   b. Depth of the burn
   c. Severity of the burn

B. Scene size-up

1. Scene safety
   a. Observe the scene for hazards and threats to the safety of you and your crew, bystanders, and the patient.
   b. Ensure that the factors that led to the patientôs burn injury do not pose a hazard to you and your crew.
2. MOI/NOI
   a. Attempt to determine the type of burn that has been sustained and the MOI.
   b. Assess the scene for any environmental hazards.
   c. Determine the number of patients.
   d. Call for additional resources early, if necessary.
   e. Consider the potential for spinal injuries, inhalation injuries, and other injuries.

C. Primary assessment

1. Begins with a rapid scan
2. Form a general impression.
   a. Look for clues to help identify how serious the injuries are and how quickly you need to assess and treat them.
   b. Be suspicious of clues that may indicate abuse.
   c. Always consider the need for manual spinal stabilization.
   d. Check for responsiveness using the AVPU scale.
   e. In all patients whose level of consciousness if less than alert and oriented, administer high-flow oxygen via a nonrebreathing mask and provide immediate transport.
3. Airway and breathing
   a. Ensure that the patient has a clear and patent airway.
   b. Be alert to signs that the patient has inhaled hot gases or vapors:
      i. Singed facial hair
      ii. Soot present in or around the airway
   c. Copious secretions and frequent coughing may indicate a respiratory burn.
   d. Quickly assess for adequate breathing.
   e. Inspect and palpate the chest wall for DCAP-BTLS.
4. Circulation
   a. Quickly assess the pulse rate and quality.
   b. Determine perfusion based on the patientôs skin condition, color, temperature, and capillary refill time.
   c. Take the necessary steps to control significant bleeding.
   d. Shock frequently develops in burn patients.
5. Transport decision

a. Consider quickly transporting a patient who has:
   i. An airway or breathing problem
   ii. Significant burn injuries
   iii. Significant external bleeding
   iv. Signs and symptoms of internal bleeding
b. A rendezvous with ALS providers may be appropriate.

D. History taking

1. Investigate the chief complaint.
   a. Be alert for signs or symptoms of other injuries due to the MOI.
   b. Obtain a medical history and be alert for injury-specific signs and symptoms and pertinent negatives.
   c. Typical signs of a burn are:
      i. Pain
      ii. Redness
      iii. Swelling
      iv. Blisters
      v. Charring
   d. Typically symptoms include pain and/or burning at the injury site.
   e. Regardless of the type of burn injury, it is important for you to:
      i. Stop the burning process.
      ii. Apply dressing to prevent contamination.
      iii. Treat the patient for shock.
2. SAMPLE history
   a. Along with the SAMPLE history, be sure to ask the following questions:
      i. Are you having any difficulty breathing?
      ii. Are you having any difficulty swallowing?
      iii. Are you having any pain?
   b. Check whether the patient has an emergency medical identification device.

E. Secondary assessment

1. Physical examinations
   a. Perform a full-body scan.
   b. Assess the patient from head to toe looking for DCAP-BTLS.
   c. Make a rough estimate, using the rule of nines, of the extent of the burned area.
   d. Determine what classification of burns the victim has sustained.
   e. Determine the severity of the burns.
   f. Package the patient for transport based on your findings.
   g. Assessment of the respiratory system involves looking, listening, and feeling.
      i. Look for soot around the mouth, soot around the nose, or singed nasal hairs.
      ii. Listen to breath sounds with a stethoscope.
      iii. Assess pulse rate and quality; determine the skin condition, color, and temperature; and check the capillary refill time.
   h. Assess the patientôs neurologic system, including:
      i. Level of consciousness
      ii. Pupil size and reactivity
      iii. Motor response

iv. Sensory response

i. Assess the musculoskeletal system.

i. Raccoon eyes, Battleôs sign, and/or drainage of blood or fluid from the ears or nose

ii. Jugular vein distention and tracheal deviation

iii. Check the pelvis for stability.

iv. Check the abdomen.

v. Check the extremities, and record pulse, motor, and sensory function.

2. Vital signs

a. Determining an early set of vital signs will help you to know how your patient is tolerating his or her injuries.

b. Blood pressure, pulse, and skin assessment for perfusion are important signs to obtain.

c. Monitoring devices

i. Oxygenation

ii. Circulatory status

iii. Blood pressure

F. Reassessment

1. Repeat the primary assessment and reassess the patientôs vital signs.
2. Reassess the patientôs chief complaint.
3. Reevaluate interventions and treatment you have provided to the patient.

a. Stop the burning process.

b. Assess and treat breathing.

c. Support circulation.

d. Provide rapid transport.

e. Oxygen is mandatory for inhalation burns but is also helpful in patients with smaller burns.

f. If the patient has signs of hypoperfusion, treat aggressively for shock and provide rapid transport.

4. Communication and documentation

a. Provide hospital personnel with a description of how the burn occurred.

b. Include the extent of the burns.

i. Amount of body surface area involved

ii. Depth of the burn

iii. Location of the burn

c. If special areas are involved, they should be specifically mentioned and documented.

X. Emergency Medical Care for Burns

A. Your first responsibility in caring for a patient with a burn is to stop the burning process and prevent additional injury.

B. When caring for a burn patient, follow the steps in Skill Drill 24-3.

XI. Dressing and Bandaging

A. All wounds require bandaging.

1. Sometimes splints can help control bleeding and provide firm support for dressing.
2. Many different types of dressings and bandages exist.

3. Dressings and bandages have three functions:
   a. To control bleeding
   b. To protect the wound from further damage
   c. To prevent further contamination and infection

B. Sterile dressings

1. Most wounds will be covered by:
   a. Universal dressings
   b. Conventional 4nj× 4njand 4nj× 8njgauze pads
   c. Assorted small adhesive-type dressings and soft self-adherent roller dressings
2. The universal dressing is ideal for covering large open wounds.
3. Gauze pads are appropriate for smaller wounds.
4. Adhesive-type dressings are useful for minor wounds.
5. Occlusive dressings prevent air and liquids from entering (or exiting) the wound.
   a. Made of Vaseline gauze, aluminum foil, or plastic
   b. They are used to cover sucking chest wounds, abdominal eviscerations, and neck injuries.

C. Bandages

1. To keep dressings in place during transport, you can use:
   a. Soft roller bandages
   b. Rolls of gauze
   c. Triangular bandages
   d. Adhesive tape
2. The self-adherent, soft roller bandages are easiest to use.
3. Adhesive tape holds small dressings in place and helps to secure larger dressings.
   a. Some people, however, are allergic to adhesive tape; use paper or plastic tape instead.
4. Do not use elastic bandages to secure dressings.
   a. If the injury swells, the bandage may become a tourniquet and cause further damage.
   b. Always check a limb distal to a bandage for signs of impaired circulation and loss of sensation.
5. Splints are useful in stabilizing broken extremities, and they can be used with dressings to help control bleeding from soft-tissue injuries.
6. If a wound continues to bleed despite the use of direct pressure, quickly proceed to the use of a tourniquet.

XII. Summary

A. The skin protects the body by keeping pathogens out, water in, and assisting in body temperature regulation.

B. There are three types of soft-tissue injuries: closed injuries, open injuries, and burns.

C. Closed soft-tissue injuries are characterized by a history of blunt trauma, pain at the site of injury, swelling beneath the skin, and discoloration. Contusions, hematomas, and crushing injuries are classified as closed injuries.

D. Treat a closed soft-tissue injury by applying the mnemonic RICES: Rest, Ice, Compression, Elevation, and Splinting.

E. Open injuries differ from closed injuries in that the protective layer of skin is damaged. Abrasions, lacerations, avulsions, and penetrating wounds are classified as open injuries.

F. Treat an open soft-tissue injury by applying direct pressure with a sterile bandage using a roller bandage, and splint the extremity.

G. The assessment of an open injury is generally easier than the assessment of a closed injury because you can see the injury.

H. Burns are serious and painful soft-tissue injuries caused by heat (thermal), chemicals, electricity, or radiation.

I. Burns are classified primarily by the depth and extent of the burn injury and the body area involved.

J. Burns are considered to be superficial, partial-thickness, or full-thickness based on the depth involved.

K. When providing emergency care for burns:

1. Use standard precautions.
2. Cool burned area to prevent further damage.
3. Remove jewelry and constrictive clothing.

L. When providing emergency care for burns:

1. Ensure an open and clear airway, provide high-flow oxygen, be alert to signs and symptoms of inhalation injury.
2. Place sterile dressings over the burned area, cover patient with a blanket, and transport promptly.

M. Small animal and human bites can lead to serious infection and must be evaluated by a physician. Small animals can carry rabies.

N. Dressings and bandages are designed to control bleeding, protect the wound from further damage, prevent further contamination, and prevent infection.

Post-Lecture

Unit Assessment

1. State the three major functions of the skin.

2. Another name for a bruise is a(n)_____.

3. A jagged cut in the skin is called a(n)_____.

4. What does the acronym RICES stand for?

5. Describe the steps used to control bleeding from an open soft-tissue injury.

6. Why should an evisceration be kept moist and warm?

7. When would it be appropriate to remove an impaled object?

8. What are the critical areas of the body relating to burns?

9. A burn that appears blistered would be classified as a(n) _____.

10. How long should a chemical burn be flushed with water?

Knowledge Objectives

Knowledge Objectives