11 BASIC WOUND CARE

CORE CONCEPTS

- Identify the types of wound injuries.
- Explain the stages of wound healing.
- Describe emergency treatment of specific wound types.
- Identify drainage systems used in wound management.
- Document care provided to wound injuries.

INTRODUCTION

The skin is the largest organ of the body. It acts as a barrier to protect the body from the potentially harmful external environment. It can also help control temperature and retain or release fluids. When the skin's integrity is broken, the body's internal environment is open to microorganisms that may cause **infection**. Any abnormal opening or break in the skin is a wound. Wounds are not restricted to the three layers of the skin (**epidermis**, **dermis**, and s**ubcutaneous layer**) (Figure 11-1); they may affect other tissues and organs as well.

You will likely encounter patients needing wound care. Understanding the wound healing process and proper wound care management for a variety of wounds is essential in any health care setting.

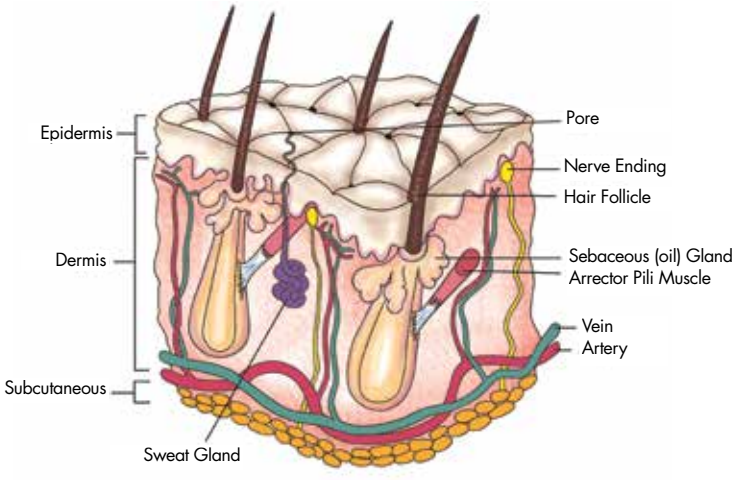

Figure 11-1. Anatomy of the skin.

TYPES OF WOUNDS

Soft–tissue injuries involve the skin and underlying subcutaneous tissue and muscles. They are classified as closed or open wounds.

Closed Wound

A closed wound is an injury to the soft tissue (damaged dermis), without a break in the skin. Closed wounds usually occur from forceful contact with a hard object. They include hematomas and crush injuries.

Figure 11-2. Intramuscular hematoma development and progression over an 86-hour period. Photograph by Whoisjohngalt, CC BY-SA 4.0. Reproduced from Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Hematoma_development.png

Hematomas often appear as well-defined pockets of **extravasated** blood and fluid beneath the skin caused by leakage from a break in a blood vessel (Figure 11-2). Hematomas consist of a mass of blood (usually clotted) confined to an organ, tissue, or internal space. A contusion (bruise) is a type of hematoma caused by bleeding

beneath the skin into the soft tissue. The bleeding can be minor or extensive. Extensive bleeding can cause severe pain and edema, leading to a compromise of vital structures.

In crush injuries, force transmitted from the body's exterior to its internal structures compresses and damages tissue. There are systemic effects of prolonged traumatic muscle compression, including **rhabdomyolysis** and **hyperkalemia**.

Open Wound

An open wound is an injury to soft tissue with a break in the skin. Generally, they are more serious than closed injuries due to the potential for blood loss and infection. There are numerous types of open wounds:

Figure 11-3. An abrasion. Photograph by Paul Sullivan, CC BY-ND 2.0. Reproduced from https://www.flicker.com/photos/pfsullivan_1056/8253117196

- **Abrasion**. A superficial loss of skin (the epidermis and possibly the dermis) resulting from rubbing or scraping the skin over a rough or uneven surface (Figure 11-3).
- **Laceration**. Wounds caused by shear forces that produce a tear in tissues (Figure 11-4). The partial- or full-thickness separation of skin and underlying tissue can be irregular (jagged) or sharp (incisional).
- **Puncture**. Penetration of the skin by a pointed object (Figure 11-5). It can be penetrating (an entrance wound only) or perforating (both an entrance and an exit wound). Generally, puncture wounds do not cause serious external bleeding, but there may be significant internal bleeding and damage to vital organs.

Figure 11-4. A laceration. Photograph courtesy of Captain Steven M. Self.

Figure 11-5. A patient whose knee was punctured by a dart. Photograph by Dr. James Heilman, MD. Reproduced from Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Knee_puncture.jpg

- **Avulsion**. A torn or lost flap of skin (Figure 11-6). A portion of tissue separated from its base. It is either lost or left with a narrow base of attachment.
- **Amputation**. A traumatic cutting or tearing injury in which an appendage (eg, finger, toe, arm, or leg) is either partially or completely severed (Figure 11-7).
- **Burn**. A tissue injury caused by thermal, chemical, electrical, or radiation energy. First-degree burns involve only the epidermis (Figure 11-8), second-degree burns involve the epidermis and dermis (Figure 11-9), and third-degree burns involve all three layers of skin (Figure 11-10).
- **Bite**. An abrasion, puncture, or lacerated wound from the teeth or jaw inflicted by an insect, human, or animal (Figure 11-11). Consider all bites contaminated.

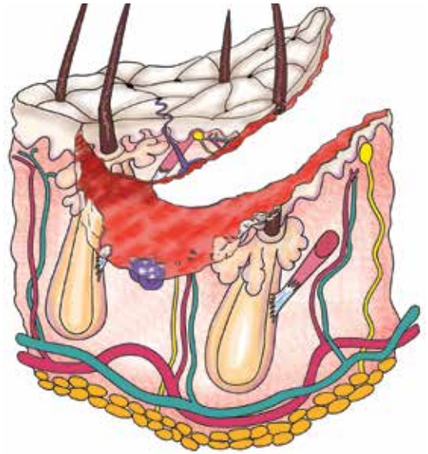

Figure 11-6. An avulsion, showing a flap of skin.

Figure 11-7. A patient who suffered bilateral traumatic amputations. Reproduced from Nessen SC, Lounsbury DE, Hetz SP, eds. *War Surgery in Afghanistan and Iraq: A Series of Cases, 2003-2007*. Washington, DC: Department of the Army, Office of the Surgeon General, Borden Institute; 2008: 289.

Figure 11-8. A first-degree burn (a sunburn). Photograph by QuinnHK. Reproduced from Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Sunburn.jpg

Figure 11-9. A severe second-degree burn to a patient's right hand. Photograph by Westchaser. Reproduced from https://commons.wikimedia.org/wiki/File:Major-2nd-degree-burn.jpg

Figure 11-10. Third-degree burns. Reproduced from Renz E, Cancio L. Acute Burn Care. In: *Combat Casualty Care: Lessons Learned from OEF and OIF*. Washington, DC: Department of the Army, Office of the Surgeon General, Borden Institute; 2012: 599, fig 5.

Figure 11-11. A child who suffered a dog bite to the face. Photograph by Tanner Ford, TRFPhotography, Reproduced from Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Hundebiss_Kind_export.jpg

Note: Crush injuries may be closed or open.

Check on Learning

1. What are the two broad classifications of wound injuries?
2. List four examples of open wound injuries.
3. Name one example of a closed wound injury.

WOUND HEALING

Types of Wound Healing

Wound healing differs depending on the extent of tissue damage. Wound healing occurs by first, second, and third intention. In all cases, wound healing requires adequate circulation to assist with the healing process, by aiding in decreasing infections and increasing tissue perfusion with oxygenated blood.

First-Intention Healing

The period of wound closure immediately following the injury and prior to the formation of **granulation** tissue is first-intention healing or healing by primary intention. First-intention healing occurs when there is minimal tissue loss (eg, in surgical incisions or minor accidental cuts). In this phase, the wound edges are clean and aligned directly next to one another. The wound edges are well-approximated (brought into alignment, with edges touching) and usually closed with sutures, staples, or adhesives at the time of initial evaluation. There is little to no tissue loss and minimal scarring. Infection rates with first-intention healing are low. Most surgical incisions heal by primary intention.

Second-Intention Healing

Second-intention healing, also known as healing by secondary intention, occurs when the wound edges are widely separated due to tissue loss. The wounds heal without surgical closure. Second-intention healing occurs in injuries such as deep lacerations, burns, and pressure ulcers. Since the edges in these wounds do not approximate, openings slowly fill with granulation tissue. Granulation is the part of the healing process in which rough, pink tissue containing new connective tissue and capillaries form around the edges of the wound. Granulation tissue must extend from the edges inside the wound toward the center. Granulation is both normal and desirable, and it prevents **abscess** formation. As the wound gradually fills in, **epithelialization** will occur, completing the skin healing process.

Second-intention healing is slow. Drainage from infection or other wound debris prolongs healing. Broad scarring often occurs and the risk of infection is greater than that for first-intention healing. Wound care includes cleaning and minimal debridement. Daily care is imperative to ensure wound debris removal and to allow for granulation tissue formation.

Third-Intention Healing

Third-intention healing is also known as delayed primary closure or tertiary intention. It occurs when there is a delay in the time between the injury and the closure of the wound. For example, leaving a wound open temporarily after surgery facilitates drainage or removal of infectious materials. When there is infection, or a large open wound, the wound is closed later. In the meantime, wound surfaces start to granulate. Deep scarring almost always occurs.

Sometimes, wound management combines first and secondary intentions to promote healing. To use this strategy, clean, debride, irrigate, and observe the wound for a period of time (typically 4 or 5 days) before closure. Place dressing material inside the wound to keep the edges apart.

Factors That Complicate Wound Healing

The following factors complicate the wound healing process:

- **Extent of the injury.** Depth, width, and length affect healing.
- **Type of injury.** Animal bites, burns, and fractures commonly complicate healing.
- **Infection.** A disease caused by microorganisms (especially those that release toxins or invade and multiply in body tissues) that limit healthy tissue formation and may cause other adverse reactions.
- **Patient's nutritional status.** Malnutrition affects all phases of wound healing by impeding normal healing processes. Some conditions that may occur in malnourished patients are pressure ulcers and infections. Physiological stress from burns or severe trauma increases nutritional requirements and complicates healing. The patient's diet should include protein, carbohydrates, lipids, vitamins A and C, and minerals.
- **Patient's age.** Starting at about age 30, our organ systems lose about 1% of their function each year.[1] Most military personnel will not be severely affected by the degradation of wound healing based on age. Vascular changes impair circulation to the wound site. Reduced liver function alters synthesis of clotting factors. Reduced antibody and lymphocyte production impairs the body's ability to fight infection. **Collagen** tissue becomes less pliable as individuals age, which slows new tissue growth.

- **Obesity**. Fatty tissue lacks an adequate blood supply to aid in decreasing infection, placing the patient at risk for complications. Watch obese patients (of any age) closely for signs of wound infection, **dehiscence**, and evisceration.
- **Impaired oxygenation**. If local circulating blood flow is poor, due to factors such as swelling or tissue damage, tissues do not receive sufficient oxygen. Decreased hemoglobin (eg, in hemorrhagic shock or anemia) reduces arterial oxygen levels in capillaries and interferes with tissue repair.
- **Smoking**. Tobacco cigarettes, electronic cigarettes, and vapors with nicotine can reduce the amount of functional hemoglobin in blood, decreasing tissue oxygenation and interfering with normal cellular mechanisms that promote the release of oxygen to tissue. Nicotine is a vasoconstrictor that can result in tissue ischemia from inadequate blood flow.
- **Drugs**.
  - Anti-inflammatory drugs (eg, steroids and NSAIDs) suppress **protein synthesis**, epithelialization, and the inflammatory response. Inflammation is a normal part of the wound healing process. It is important for removal of contaminating microorganisms.
  - Prolonged antibiotic use increases the risk of resistance. **Antibiotic resistance** makes some infections difficult to treat and slows wound healing. This could lead to complications, some of which require multiple surgical interventions. In addition, a medical officer (MO) may prescribe stronger antibiotics in response to resistance. These stronger antibiotics are also subject to resistance, perpetuating a cycle of increasingly powerful drugs required to treat infections.
  - Chemotherapeutic drugs can depress bone marrow function (blood cell production), leukocyte (white blood cell) number, and inflammatory response.
- **Diabetes mellitus**. Diabetes causes small blood vessel disease, which impairs tissue perfusion. It causes hemoglobin to have greater affinity for oxygen, so it fails to release oxygen to tissues. It alters the ability of leukocytes to perform **phagocytosis**.

Check on Learning

4. What are the three types of wound healing?
5. Name eight factors that complicate the wound healing process.
6. Why is it important to have adequate circulation to a wound?

WOUND ASSESSMENT

The following steps detail wound assessment.

History

1. Obtain a history of the wound injury utilizing the **OPQRST** method. How did the wound occur? How long ago did the injury occur? What type of object caused the injury?
2. Assess for pain level. Is there numbness or tingling distal to the injury? Assess pulse, motor, and sensory function.

Inspection

3. Examine the skin color surrounding the wound.
4. Observe the color of the wound bed tissue.
   a. Pink tissue usually indicates healthy, granulating, viable tissue.
   b. Black tissue indicates necrotic tissue.
   c. White or yellow tissue can indicate an infectious process.
5. Determine the wound size (length × width × depth). Depth can be described by stating the visible tissue (eg, wound extends to subcutaneous tissue, to muscle, or to bone). Document the measurements in inches (eg, 1 × 3 × 2 in.) or by using a commonly known object, such as a dime (eg, a "dime-sized" wound).
6. Observe the wound boundaries. Are the edges of the wound smooth or irregular?
7. Examine the wound for drainage. If the wound is draining, note the color (**sanguineous**, **serosanguineous**, **serous**, **purulent**), amount (small, moderate, copious), and odor (a foul smell can indicate infection; wounds with an unpleasant smell are described as **malodorous**).

Palpation

8. Palpate the wound for temperature around the area.
9. Assess the neurovascular status of the affected extremity distal to the injury. Do not treat wounds before completing this assessment.
   a. Check the pulse quality, location, and rate distal to the wound. If a pulse site is not available distal to the wound, attempt to use capillary refill. Loss of a pulse or coldness of the extremity distal to the injury indicates pressure on an artery and may require immediate medical intervention.
   b. Check the sensation and motor function of the affected extremity distal to the wound. This helps identify peripheral nerve insult (damage to nerve) from an event possibly caused by direct injury, compression, or edema.

Note: Assess and document tetanus immunization status for any patient with an open wound.

Note: Always remember to manage life-threatening massive hemorrhage, airway, respiration, circulation, and hypothermia problems prior to treating wounds.

WOUND MANAGEMENT

Proper wound management contributes to the healing process by preventing infection and other complications. Wound healing is a normal biological process in the human body, which takes place in four stages: hemostasis, inflammation, proliferation, and remodeling. Influencing collagen maturation through proper wound management speeds up healing and minimizes scarring.

Good wound management starts with evaluating the following factors:

- the patient's current nutritional status;
- vascular status distal to the injury (compared to the uninjured extremity), if applicable;
- color of the injured extremity;
- capillary refill;
- pulses distal to the injury;
- neurologic assessment of the injured extremity;
- history of the injury to include when and how the wound occurred;
- abnormal wound healing processes;
- wound infection; and
- appropriate dressing for the wound.

Use the information in evaluation to develop the best wound management plan for each patient.

Guide to Tetanus Prophylaxis in Wound Management

Tetanus is an acute, often fatal disease (Figure 11-12). Although it occurs worldwide, it is rare in developed countries due to widespread immunization. Document tetanus immunization status for any patient with an open wound. Recruits lacking a reliable history of previous immunization receive a primary series of tetanus-diphtheria toxoid. Recruits with a tetanus immunization history receive a booster dose of toxoid upon entering active duty. All adults should receive booster doses of toxoid every 10 years. In tetanus-prone wounds (dirty wounds), administer 0.5 mL of tetanus-diphtheria toxoid intramuscularly if more than 5 years have elapsed since the patient's last dose. If medical records are not available and the patient cannot remember the date of his or her last toxoid booster, administer a booster dose.

Figure 11-12. A patient infected with the *Clostridium tetani* exotoxin (tetanus) experiencing extreme muscle spasms in the neck and back, which result in the posturing of the body known as opisthotonos. Content provided by CDC. Reproduced from Public Health Image Library (PHIL). https://phil.cdc.gov/Details.aspx?pid=6373

Note: The bacteria that cause tetanus exist as spores in soil. The spore gains access through a cut or wound and then germinates, and the tetanus bacteria begin producing a toxin that affects the nervous system and causes painful muscle contractions. The disease is also called lockjaw, because stiffness and pain in the muscles of the neck and jaw are common early symptoms.

Check on Learning

7. When assessing a wound, what four things do you observe?
8. Why is it important to check the neurovascular status of the affected extremity prior to wound treatment?

Treatment of Specific Wound Types

Note: Always remember to manage the patient's massive external hemorrhage, airway, breathing, circulation, and hypothermia or head injury (MARCH) prior to performing wound care.

Hematoma

To assess a hematoma or contusion, first inspect the skin for visible changes such as discoloration and swelling due to damage to underlying vessels, nerves, and bony structures. Next, evaluate peripheral pulses, sensation, motor function, strength, and the need for pain control. Elevate the contused area or extremity and apply ice packs within the first 24 hours.

Abrasion

Assess for dirt and other substances in the wound bed tissue and assess the need for tetanus prophylaxis. Evaluate functional capabilities. To treat an abrasion, clean the wound surface by manually removing large pieces of foreign matter. Do not scrub the wound bed tissue. Irrigate debris from the wound using a 30 to 60 mL syringe filled with normal saline or sterile water. Control bleeding, then apply a sterile dressing to the wound.

Laceration

Assess the wound depth. Control bleeding and check for associated injuries. Evaluate the neurovascular status of the affected extremity (as appropriate), checking pulse quality, location, and rate. Observe capillary refill. Note the patient's skin color, temperature, sensation, and motor function. Determine the need for pain control and tetanus prophylaxis. If the wound involves an extremity, treat by first controlling bleeding with direct pressure and elevation. Next, thoroughly cleanse and irrigate the wound using a 30 to 60 mL syringe filled with normal saline or sterile water. For a minor laceration, use a butterfly bandage and cover it with a gauze dressing. For a major laceration, consider the need for sutures, staples, or surgery. Consult the MO about the appropriate closure technique.

Crush Injury

In crush injuries, prolonged traumatic muscle compression causes tissue damage, often followed by systemic effects. If there is an open wound, first control bleeding by applying direct pressure or a pressure dressing. Manage all crush injuries as if there is internal bleeding and treat for shock if you believe there is any possibility of internal injuries. Evaluate the neurovascular status of the extremities, checking pulse quality, location, and rate (capillary refill is not a reliable perfusion indicator in adults). Observe the patient's skin color (eg, pale, flushed, jaundiced). Determine the need for pain control and tetanus prophylaxis. Apply a dry, sterile dressing and elevate the extremity. Splint extremities that are painful, swollen, or deformed. Crush injuries can develop into **compartment syndrome**, muscle necrosis, and leakage of muscle cell contents into systemic circulation, especially after restoration of blood to damaged tissues. In addition, the compressive forces of crush injury can break bones and damage muscles, nerves, and other tissues, as well as rupture organs, leading to internal hemorrhage. Refer the patient to an MO as soon as possible.

Caution: Crush injury is a limb-threatening event. If suspected, do not elevate the affected limb above the level of the heart. This may decrease perfusion to the compromised extremity.

Avulsion

The first step in treating an avulsion is to assess the amount of tissue loss. Next, observe the depth of the injury. Determine the need for pain control and tetanus prophylaxis. Control bleeding and clean the wound surface. For attached skin, clean the wound and fold the skin back to its normal position. Dress the wound using a bulky pressure dressing. For detached skin, dress the wound using a bulky pressure dressing. Save the avulsed part by wrapping it in dry, sterile gauze and placing it in a plastic bag, if available. Keep the avulsed part as cool as possible, but do not immerse it in cooled water or saline.

Punctures and Penetrations

Assess the wound for foreign bodies or materials and impaled objects, check the depth of the penetration for possible underlying structural damage, and evaluate the type and degree of contamination. Determine the need for pain control and tetanus prophylaxis. Do not remove any impaled object. Removing the object may cause further injury to nerves, muscles, and other soft tissues and also cause severe hemorrhage. Expose the wound and control profuse bleeding by applying pressure on either side of the impaled object and pushing downward. Stabilize the impaled object with a bulky dressing.

Warning: DO remove an impaled object to the cheek if there is airway compromise.

Amputation

Assess and control bleeding first, then evaluate neurovascular status (pulse quality, location, and rate), capillary refill, skin color and temperature, sensation, and motor function (in partially amputated limbs). Determine the need for pain control and tetanus prophylaxis. Rinse the amputated part with saline; wrap it in a moist, sterile gauze pad or towel; and put it in a plastic bag or plastic container. Place that plastic bag or container in an ice-filled container, if available.

Check on Learning

9. Name three types of wounds and describe the treatment for each.
10. Why is it important to leave an impaled object in place? What is the exception?

Types of Dressings

Gauze

Gauze dressings are highly absorbent and ideal for wounds that are fresh and likely to bleed or drain significantly. However, unless moist, these dressings can remove granulation tissue.

Transparent Dressings

The chief advantage of transparent dressings is that wound assessment may not require dressing removal. They are less bulky than gauze dressings and do not require tape to secure them. However, transparent dressings are not absorbent. Do not use them on wounds that are bleeding or draining significantly.

Hydrocolloid Dressings

Hydrocolloid dressings are self-adhesive, opaque, air- and water-occlusive wound coverings that reduce pain from air exposure. These products interact with moisture on the skin to produce a gel, which provides a moist healing environment. This allows for fewer dressing changes and provides better protection from bacteria. Use hydrocolloid dressings in shallow to moderate depth wounds and when drainage is minimal.

Changing a Gauze Dressing

Change dressings when ordered by the MO, when the wound requires assessment or care, or when the dressing becomes loose or saturated with drainage.

Use the following supplies and equipment for a gauze dressing change:

- clean gloves
- individually packaged gauze dressings
- adhesive tape
- small basin or container
- normal saline or sterile water
- 30 to 60 mL syringe for irrigation
- waterproof pad

Prepare to Change Dressing

To change the dressing, follow the steps below.

1. Perform a patient care hand wash (see Chapter 2, Infection, Asepsis, and Sterile Technique).
2. Explain the procedure to the patient.

3. Don appropriate PPE (minimum gloves and eye protection).
4. Position the patient and expose the areas to be re-dressed.
5. Place the underpad (chux pad) under the patient, below the wound to be re-dressed.
6. Remove the dressing.
   a. Gently loosen the tape toward the wound while supporting the skin around the wound.
   b. Remove the dressing. Be careful not to tear the wound or dislodge any drains.
   c. Use sterile saline to moisten the dressing if it is sticking to the wound. This prevents discomfort to the patient, and maintains the integrity of any sutures.
7. Assess the amount, color, odor, and consistency of drainage on the old dressing.
8. Dispose of the old dressing in a red biohazard bag.
9. Inspect and assess the wound bed tissue.

Warning: During combat conditions, do not remove an existing dressing. Reinforce it with additional dressings instead.

Irrigate and Clean the Wound

10. Pour a small amount of irrigation liquid (normal saline or sterile water) into a waste receptacle to prevent contamination and to clean the bottle rim. If the seal of the bottle is intact, this step is not necessary. Pour irrigation liquid into a sterile basin and fill the 30 to 60 mL syringe with liquid from the basin.
11. Hold the tip of the syringe just above the top end of the wound and force fluid into the wound slowly and continuously. Use enough force to flush out debris, but do not squirt or splash the fluid. Irrigate all portions of the wound, but do not force solution into wound pockets. Continue irrigating until the solution draining from the bottom end of the wound is clear.
12. Gently, pat dry the wound tissue and edges with sterile gauze. Work from the cleanest to the most contaminated areas.

Apply a New Dressing

13. Place the inner dressing over the wound, ensuring the dressing extends past the edges of the wound. All other dressings will overlap each other to cover the entire wound.
14. Cover all inner dressings with a larger outer dressing.
15. Apply tape to secure the dressing.
16. Remove gloves and place them in a red biohazard bag.
17. Reposition and cover the patient.
18. Wash your hands.

Caution: Wounds that must be kept moist (eg, abdominal evisceration) require "wet-to-dry" dressings. Dampen the inner dressings with a solution (usually normal saline) before application. Apply dry outer dressings.

Caution: Tape should not form a constricting band around the wound or extremity.

Document

19. Document wound care and wound assessment on the patient's SF 600, Chronological Record of Medical Care. Enter the date and time of the procedure and a description of the wound's color, dimensions, odor, consistency, and amount of drainage.

Check on Learning

11. Name three types of dressings used to cover a wound.
12. What is the procedure for changing a gauze dressing?

Drainage and Drainage Systems

Drainage is an important part of wound healing. Drainage results from inflammation and the type of fluid provides information about the healing process. Exudate is fluid that has leaked out from blood vessels into surrounding tissues. The types of exudates are:

- **serous**—clear, watery fluid seen during healing of most types of wounds;
- **sanguineous**—bright red, bloody fluid, usually from deep wounds;

- **serosanguineous**—a mixture of serous fluid and blood, often seen where there is some skin loss; and
- **purulent**—a milky, pus-filled fluid that indicates infection.

When the patient first ambulates after **drain** insertion, drainage may increase slightly. Continuous sanguineous drainage may indicate that small blood vessels are oozing. Minor draining from a wound is a normal process that assists with healing.

Note: Not all surgical wounds drain.

The color, amount, and odor of the drainage are important characteristics to document when assessing healing or identifying signs of infection.

Note: Exudate or drainage greater than 300 mL in the first 24 hours is abnormal.

Figure 11-13. A casualty with a drain tube inserted after surgery to repair the left elbow. Reproduced from Nessen SC, Lounsbury DE, Hetz SP, eds. *War Surgery in Afghanistan and Iraq: A Series of Cases, 2003-2007*. Washington, DC: Department of the Army, Office of the Surgeon General, Borden Institute; 2008: 230.

Wound drainage systems use a device to remove excess fluid from a wound or body part. Open drains are those that pass through an open-ended tube into a receptacle or out onto the dressing (Figure 11-13). For example, a Penrose drain is a soft tube that is inserted and then pulled out in stages as the wound heals from the inside out. Closed (suction) drains are self-contained suction units that connect to drainage tubes within the wound. Closed drains are more effective than open drains because they pull fluid by creating a vacuum via negative pressure. They also prevent environmental contaminants from entering the wound or cavity. There are two types of portable devices that provide constant, low-pressure suction to remove drainage without wall suction. Use a Jackson-Pratt drain when expecting small amounts (100–200 mL) of drainage. Use a larger-capacity negative pressure drain for amounts up to 500 mL, such as a Hemovac drainage system (Zimmer Inc, Warsaw, IN).

Check on Learning

13. Give two examples of a closed drainage system.
14. Name the three types of drainage from uninfected wounds and provide an example of each.

Assisting With Ongoing Wound Management

Evaluate wounds after the following events:

- dressing change,
- application of heat and cold therapies,
- irrigation,
- stress to the wound site, and
- when the patient reports increased pain at the wound site.

Assess the condition of the wound and dressing. Ask whether the patient notes any discomfort during dressing changes and inspect the condition of dressings at least every shift. Proper documentation includes the wound location, size (length × width × depth), drainage type and amount, odor, and neurovascular status. Monitor vital signs; distal peripheral pulses; skin color, sensation, and temperature; and motor function. Provide pain control as needed.

Wound Complications

Watch closely for complications such as any impaired wound healing. Some wound complications can be life threatening.

Wound bleeding may indicate a slipped suture, dislodged clot, coagulation problem, or trauma placed on blood vessels or tissues. Inspect the wound and dressing to help detect drainage increases and color changes. If bleeding occurs internally, the dressing may remain dry, while the abdominal or thoracic cavity collects blood. Signs of internal bleeding include:

- increased thirst;
- restlessness;
- rapid, thready pulse;
- decreased blood pressure;
- decreased urinary output;
- cool, clammy skin; and
- rigid, distended abdomen.

Warning: If not detected, hypovolemic shock can cause circulatory system collapse and death.

Warning: Evisceration is a true surgical emergency. Notify the MO immediately.

Dehiscence may result after periods of sneezing, coughing, or vomiting. The patient may say that something has "given way." Evidence of new or increased serosanguineous drainage on the dressing is an important sign. In the case of dehiscence, the patient should remain in bed and take in nothing by mouth. Advise the patient to refrain from coughing. Reassure the patient. Place a sterile dressing over the area until the MO evaluates the site.

In the case of evisceration, the patient should remain in bed. Cover the wound and its contents with warm, sterile saline dressings and notify the MO immediately.

A patient with an infected wound displays the following:

- fever,
- tenderness,
- increased pain at the wound site,
- edema, and
- elevated white blood cell count.

According to the Centers for Disease Control and Prevention, infected wounds contain purulent (pus) drainage. Purulent drainage has a foul odor and is brown, yellow, green, or white depending on the associated pathogen.

Other wound complications of concern include compartment syndrome, cellulitis, and abscess. In some cases, you can manage compartment syndrome by loosening constrictive bandaging, and stretching or massaging the affected area. However, it may require surgical intervention. Cellulitis is a bacterial skin infection characterized by heat, pain, redness, and edema that requires antibiotic treatment. Abscess management varies depending on its type and size.

Check on Learning

15. How do you evaluate wound healing?
16. Name four types of possible wound complications.
17. Which wound complication is a surgical emergency?

SUMMARY

Wounds range from abrasions to amputations. Early assessment and management of wounds can change recovery outcomes for patients and improve their quality of life. Combat medics must understand how wound injuries occur, the various types of wounds, and the importance of providing the proper emergency care to help prevent infection, which could slow healing. A common cause of skin breakdown is pressure against tissues that cause ischemia and tissue death. Wound healing can be complex and there are many products available to ensure an optimal outcome. Follow the manufacturer's instructions, the MO's orders, and local standard operating procedures. Finally, in documenting a basic wound, note appearance and any abnormalities, pertinent history, and **pertinent negatives**.

GAUZE DRESSING CHANGE

STEP 1: Perform a patient care hand wash (see Chapter 2; Infection, Asepsis, and Sterile Technique).

STEP 2: Explain the procedure to the patient.

STEP 3: Don PPE.

STEP 4: Position the patient and expose the areas to be re-dressed.

STEP 5: Place the underpad (chux pad) under the patient, below the wound.

STEP 6: Remove the dressing. Gently loosen the tape toward the wound while supporting the skin around the wound. Do not tear the wound or dislodge drains. Use sterile saline to moisten the dressing if it is sticking to the wound.

GAUZE DRESSING CHANGE, CONT.

STEP 7: Assess for the amount, color, odor, and consistency of drainage on the old dressing.

STEP 8: Dispose of the old dressing in a biohazard bag.

STEP 9: Inspect and assess the wound bed tissue.

STEP 10a: Pour irrigation liquid into a sterile basin.

STEP 10b: Fill the 30 to 60 mL syringe with liquid from the basin.

STEP 11: Hold the tip of the syringe just above the top end of the wound and force fluid into the wound slowly and continuously. Use enough force to flush out debris, but do not squirt or splash the fluid. Irrigate all portions of the wound, but do not force solution into wound pockets. Continue irrigating until the solution draining from the bottom of the wound is clear.

GAUZE DRESSING CHANGE, CONT.

STEP 12: Gently pat dry the wound tissue and edges with sterile gauze. Work from the cleanest to the most contaminated areas.

STEP 13: Place the inner dressing over the wound, ensuring it extends past the edges of the wound. All other dressings will overlap each other to cover the entire wound.

STEP 14: Cover all inner dressings with a larger outer dressing.

STEP 15: Apply tape to secure the dressing. Tape should not form a constricting band around the wound or extremity.

GAUZE DRESSING CHANGE, CONT.

STEP 16: Remove your gloves and place them in a trash receptacle.

STEP 17: Reposition and cover the patient.

STEP 18: Wash your hands

STEP 19: Document the wound care and assessment on the patient's SF 600, Chronological Record of Medical Care.

KEY TERMS AND ACRONYMS

Abscess. A cavity surrounded by inflamed tissue and containing purulent discharge, formed because of a localized infection.

Antibiotic resistance. Antibiotics no longer work against disease-causing bacteria (eg, methicillin-resistant *Staphylococcus aureus* [MRSA]). When an antibiotic fails to kill all of the bacteria it targets, the surviving bacteria become resistant to that particular drug and frequently to other antibiotics as well.

Collagen. A white, fibrous, structural protein found in tendons, bone, cartilage, skin, and other connective tissues.

Compartment syndrome. A progressive degeneration of tissue and muscle that results from a severe interruption of blood flow when blood vessels and nerves are constricted within a space (eg, from swelling or from a tight dressing or cast). Signs and symptoms include pain with pressure over the compartment area, with diminished sensation distal to the compartment area. Diminished to absent extremity pulses distal to the injury are a late symptom.

Dehiscence. The separation of a surgical incision or rupture of a wound closure.

Dermis. The second layer of skin, which contains structures such as glands, nerves, and vessels that affect cooling, sensation, and nutrient circulation.

Drain. A device used to remove excess fluid from a wound or body part.

Epidermis. The superficial or outer layer that protects the dermis from infection and drying. It does not contain blood vessels or nerves.

Epithelialization. The regrowth of skin over a wound.

Extravasated. Blood, serum, or lymph passed or escaped into the tissues.

Granulation. The part of the healing process in which rough, pink tissue containing new connective tissue and capillaries form around the edges of the wound. Granulation is normal and desirable.

Hyperkalemia. A higher than normal blood potassium level.

Infection. The invasion and multiplication of infective agents in body tissues with a resultant reaction to their presence and their toxins.

Malodorous. Having an unpleasant smell.

OPQRST. Onset, provoking or palliative factors, quality, radiation or region, severity, and timing; used to obtain patient history information.

Pertinent negatives. The absence of certain signs and symptoms that enable the care provider to rule out some medical conditions. Use them as an aid in diagnosis.

Phagocytosis. A three-stage process by which neutrophils, monocytes, and macrophages engulf and destroy microorganisms, other foreign antigens, and cell debris.

Protein synthesis. The process all cells use to make proteins, which are responsible for all cell structure and function.

Purulent. Consisting of or containing pus. The color may be yellow, green, brown, or white.

Rhabdomyolysis. A skeletal muscle injury that results in cellular death with resultant leakage of intracellular contents.

Sanguineous. Bloody. The color is bright red or pink.

Serosanguineous. Composed of serum and blood. The color is pale red, pale pink, or clear with pink or red swirls.

Serous. A clear, watery drainage.

Subcutaneous layer. The third layer of skin insulates, adds shape to the body (adipose and connective tissue), and stores energy. It varies in thickness depending on its location.

CHECK ON LEARNING ANSWERS

1. What are the two broad classifications of wound injuries?

   Open and closed.

2. List four examples of open wound injuries.

   Any four of the following: crush, abrasion, laceration, avulsion, amputation, puncture, or bite.

3. Name an example of a closed wound injury.

   Crush or hematoma.

4. What are the three types of wound healing?

   Primary intention, secondary intention, and delayed primary closure.

5. Name eight factors that complicate the wound healing process.

   Any eight of the following: extent of injury, type of injury, infection, patient's nutritional status, age of the patient, obesity, impaired oxygenation, smoking, drugs, diabetes mellitus, poor local blood circulation, and decreased hemoglobin (anemia).

6. Why is it important to have adequate circulation to a wound?

   If local circulating blood flow is poor (swelling or tissue damage), tissues fail to receive needed oxygen. Decreased hemoglobin (in hemorrhagic shock or anemia) reduces arterial oxygen levels in capillaries and interferes with tissue repair.

7. When assessing a wound, what four things do you observe?

   Color, size, boundaries, and drainage.

8. Why is it important to check the neurovascular status of the affected extremity prior to wound treatment?

   To determine peripheral nerve insult possibly caused by direct injury, compression, or edema. To determine the need for immediate medical intervention if there is loss of the pulse or coldness of the extremity distal to the injury, indicating pressure on an artery.

9. Name three types of wounds and describe the treatment for each.

   Any three of the following:

   Contusion. Elevate the contused area or extremity. Apply ice packs within the first 24 hours.

   Crush injury. Control bleeding if an open wound, using direct pressure or a pressure dressing. Apply a dry sterile dressing. Elevate the extremity if possible. Splint extremities that are painful, swollen, or deformed. Refer to an MO as soon as possible.

   Abrasion. Clean the wound surface by manually removing large pieces of foreign matter; do not scrub the wound bed tissue. Irrigate debris from the wound using a 30 to 60 mL syringe filled with normal saline or sterile water. Control bleeding and apply a sterile dressing to the wound.

   Laceration. Control bleeding with direct pressure. Elevate lacerated extremities. Cleanse and irrigate the wound thoroughly using a 30 to 60 mL syringe filled with normal saline or sterile water. For minor lacerations use a butterfly bandage and cover with a gauze dressing. For major lacerations, consider the need for sutures, staples, or surgery. Consult with your MO about the appropriate closure technique.

   Avulsion. Control bleeding. Clean the wound surface. For attached skin, fold the skin back to its normal position after cleaning the wound and dress the wound using a bulky pressure dressing. For detached skin, dress the wound using a bulky pressure. Save the avulsed part by wrapping it in a dry, sterile gauze dressing and placing it in a plastic bag if available. Keep the avulsed part as cool as possible. Do not immerse the avulsed part in cooled water or saline.

   Amputation. Control bleeding. Rinse the amputated part with saline; wrap it in a moist, sterile gauze or towel; and place it in a plastic bag or plastic container. Place this bag or container in another container containing ice.

   Punctures and penetrations. Do not remove any impaled object. Expose the wound. Control profuse bleeding by applying pressure on either side of the impaled object and pushing downward. Stabilize the impaled object with a bulky dressing.

10. Why is it important to leave an impaled object in place? What is the exception?

    Removal of the object may cause further injury to nerves, muscles, and other soft tissues, and may cause severe hemorrhage. However, DO remove an impaled object to the cheek if there is airway compromise.

11. Name three types of dressings used to cover a wound.

    Gauze dressing, transparent dressing, and hydrocolloid dressing.

12. What is the procedure for changing a gauze dressing?

    Determine the need for a dressing change. Gather supplies and equipment. Prepare to change the dressing. Irrigate the wound. Apply the new dressing. Complete and document the procedure.

13. Give two examples of a closed drainage system.

    Jackson-Pratt drain and Hemovac.

14. Name the three types of drainage from uninfected wounds and provide an example of each

    Serous—clear, watery drainage (eg, blister).

    Sanguineous—bloody (eg, laceration).

    Serosanguineous—composed of serum and blood (eg, abscess).

15. How do you evaluate wound healing?

    Assess the condition of the wound and dressing and ask whether the patient notes any discomfort during the dressing change procedure.

16. Name four types of possible wound complications.

    Any four of the following: cellulitis, dehiscence, impaired wound healing, internal and external bleeding, compartment syndrome, abscess, evisceration, and wound infections.

17. Which wound complication is a surgical emergency?

    Evisceration.

REFERENCES

1. Limmer D, O'Keefe M, Dickinson E, et al. *Emergency Care.* 13th ed. Pearson Education; 2015.

SOURCES

Nettina SM, ed. *Lippincott Manual of Nursing Practice*. 10th ed. Wolters Kluwer Health/Lippincott Williams & Wilkins; 2014.

Rosdahl C, Kowalski M. *Textbook of Basic Nursing*. 11th ed. Wolters Kluwer Health/Lippincott Williams & Wilkins; 2017.

Stedman's Pocket Medical Abbreviations. Wolters Kluwer Health/Lippincott Williams & Wilkins; 2006.

Taber's Cyclopedic Medical Dictionary, 22nd ed. F.A. Davis Co; 2013.