# 11 Burns

## Burns

Nearly 2 million burn injuries occur each year in the United States, resulting in 75,000 hospitalizations and more than 3,000 deaths. **Burns** occur in every age group, across all socioeconomic levels, at home and in the workplace, and in urban, suburban, and rural settings. It has been estimated that about 80% of all burn injuries occur in the home, with house fires responsible for the majority of fire deaths. Most burn victims are injured as a result of their own actions.

The highest-risk age groups for burn injuries are children younger than 5 years and adults older than 55 years. Both groups may have limited ability to recognize and escape from a fire or burn incident. In addition, their relatively thinner skin predisposes them to more serious injuries. Death and complications increase dramatically for burn victims older than 55 years owing to the likelihood of preexisting health problems and their immune systems' decreased ability to fight infection.

Skin death and injury occur as the applied heat exceeds the body's ability to disperse the heat; that point starts at about 113° F. The amount and depth of skin damage depend on the heat's intensity, the duration of contact, and the skin's thickness.

### Types of Burns

Burn injuries can be classified as thermal (heat), chemical, or electrical.

- Not all **thermal (heat) burns** are caused by flames. Contact with hot objects, flammable vapor that ignites and causes a

chapter at a glance

flash or an explosion, and steam and hot liquid are other common causes of burns. Just 3 seconds of exposure to water at 140° F can cause a full-thickness (third-degree) burn in an adult. At 156° F, the same burn occurs in 1 second.

- **Chemical burns.** A wide range of chemical agents can cause tissue damage and death on contact with the skin. As with thermal burns, the amount of tissue damage depends on the duration of contact, the skin thickness in the area of exposure, and the strength of the chemical agent. Chemicals will continue to cause tissue destruction until the chemical agent is removed. Three types of chemicals—acids, alkalis, and organic compounds—are responsible for most chemical burns. Alkalis produce deeper, more extensive burns than acids.
- **Electrical burns.** The injury severity from contact with electric current depends on the type of current (direct or alternating), the voltage, the area of the body exposed, and the duration of contact. Electricity can induce ventricular fibrillation (a type of cardiac arrest), cause respiratory arrest, or "freeze" the victim to the electrical contact point with powerful muscle spasms that increase the length of exposure. Victims of low-voltage electrical injuries may have no skin burns at all but might still have cardiac or respiratory arrest.

## Thermal Burns

Evaluate a thermal burn using the following steps. These steps form the basis for treatment of thermal burns.

1. **Determine the depth (degree) of the burn.** Historically, burns have been described as first-degree, second-degree, and third-degree injuries. The terms *superficial, partial thickness,* and *full thickness* are often used by burn-care professionals because they are more descriptive of the tissue damage.
   - **First-degree (superficial) burns** affect the skin's outer layer (epidermis) Figure 11-1. Signs and symptoms include: redness, mild swelling, tenderness, and pain. Healing occurs without scarring, usually within a week. The outer edges of deeper burns often are first-degree burns.

Figure 11-1

First-degree burn.

Figure 11-2

Second-degree burn blisters.

   - **Second-degree (partial-thickness) burns** extend through the entire outer layer and into the inner skin layer Figure 11-2. Signs and symptoms include: blisters, swelling, weeping of fluids, and severe pain. The

Figure 11-3

Third-degree burn.

signs occur because the capillary blood vessels in the dermis are damaged and give up fluid into surrounding tissues. Intact blisters provide a sterile, waterproof covering. Once a blister breaks, a weeping wound results, and the risk of infection increases.

- **Third-degree (full-thickness) burns** are severe burns that penetrate all the skin layers into the underlying fat and muscle Figure 11-3. Signs and symptoms include: leathery, waxy, or pearly gray skin that is sometimes charred. It has a dry appearance because capillary blood vessels have been destroyed and no more fluid is brought to the area. The skin does not blanch after being pressed because the area is dead. The victim feels no pain from a third-degree burn because the nerve endings have been damaged or destroyed. Any pain felt is from surrounding burns of lesser degrees. A third-degree burn requires medical care and the removal of dead tissue and often a skin graft to heal properly.

2. **Determine the extent of the burn.** Skin will not ignite unless heated to thousands of degrees. However, if clothing ignites or skin is kept in contact with a heat source, such as scalding water, large areas of the skin will be injured. Determining the extent of a burn means estimating how much body surface area the burn covers. A rough guide known as the *rule of nines* assigns a percentage value of total body surface area (BSA) to each part of an adult's body Figure 11-4. The entire head is

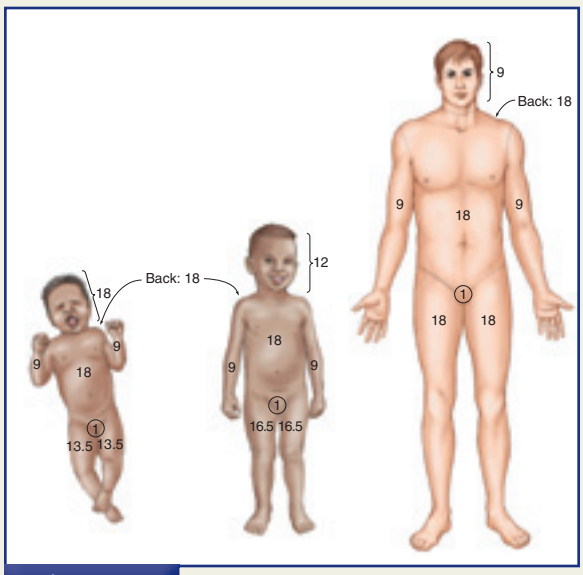



Figure 11-4

Rule of nines.

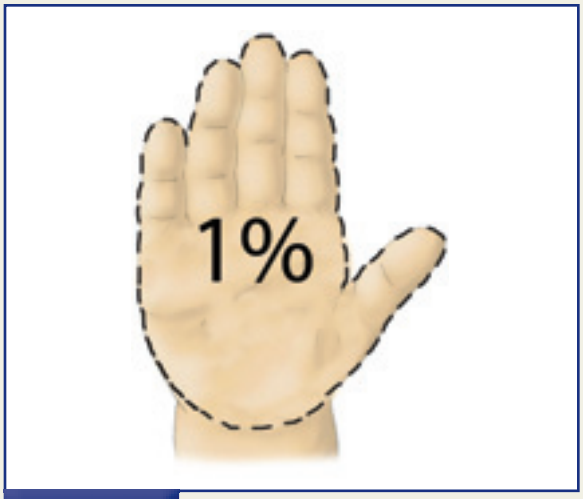



Figure 11-5

Rule of the hand.

9%, one complete arm is 9%, the front torso is 18%, the complete back is 18%, and each leg is 18%. The rule of nines must be modified to take into account the different proportions of a small child. In small children and infants, the head accounts for 18% and each leg is 14%. For small or scattered burns, use the *rule of the hand* Figure 11-5. The victim's hand, including the fingers and the thumb held together, represents

**Q&A**

**What is the rule of the palm?**

The rule of the palm says that a person's palm surface represents 1% of the BSA, but in actuality, it represents about 0.4%. The entire hand including the closed fingers and thumb represents about 0.8%. This textbook suggests using the rule of the hand—using the entire hand, including the closed fingers and thumb—as an easy method to estimate the extent of a burned area. The extent of a burn is calculated only on people with partial-thickness or full-thickness burns.

about 1% of his or her total body surface. For a very large burn, estimate the unburned area in number of hands and subtract from 100%.

3. **Determine which parts of the body are burned.** Burns on the face, hands, feet, and genitals are more severe than those on other body parts. A circumferential burn (one that goes around a finger, toe, arm, leg, neck, or chest) is considered more severe than a noncircumferential one because of the possible constriction and tourniquet effect on circulation and, in some cases, breathing. All of these burns require medical care.
4. **Determine respiratory involvement.** Respiratory tract damage caused by heat associated with a burn can cause death after a victim is hospitalized. Respiratory damage may result from breathing heat or the products of combustion, from being burned by a flame while in a closed space, or from being in an explosion. In these cases, even with no skin burn injury, there may be respiratory damage. Superheated air is absorbed by the upper respiratory tract (the area from the nose to the trachea), resulting in inflammation. Swelling occurs in 2 to 24 hours, restricting or completely shutting off the airway so that air cannot reach the lungs. All respiratory injuries must receive medical care.
5. **Determine whether other injuries or preexisting medical problems exist or if the victim is elderly** (older than 55 years) **or very young** (younger than 5 years). A medical problem or being in one of the sensitive age groups increases a burn's severity. Burns can aggravate existing medical conditions such as diabetes, heart disease, and lung disease, as well as other medical problems. Concurrent injuries such as fractures, internal injuries, and open wounds increase the severity of a burn.
6. **Determine the burn's severity** Table 11-1. This forms the basis for how to treat the burned victim. Most burns are minor, occur at home, and can be managed outside a medical setting. Seek medical care for all moderate and severe burns, as classified by the American Burn Association, or if any of the following conditions applies:
   - The victim has difficulty breathing.
   - Other injuries exist.

**Table 11-1 Burn Severity**

**Minor Burns**
- First-degree burn covering less than 50% BSA in adults (face, hands, feet, and genitals not burned)*
- Second-degree burn covering less than 10% BSA in adults
- Second-degree burn covering less than 10% BSA in children and elderly persons

**Moderate Burns**
- First-degree burn covering more than 50% BSA in adults
- Second-degree burn covering 15% to 30% BSA in adults*
- Second-degree burn covering 10% to 20% BSA in children and elderly persons
- Third-degree burn covering up to 10% BSA in adults (face, hands, and feet not burned)

**Critical Burns**
- Second-degree burn covering more than 30% BSA in adults
- Second-degree burn covering more than 20% BSA in children and elderly persons
- Third-degree burn covering more than 10% BSA in adults
- Third-degree burn covering more than 2% BSA in children and elderly persons
- Third-degree burn of hands, face, eyes, feet, or genitalia; also most inhalation injuries, electrical injuries, and burns accompanied by major trauma or significant preexisting conditions

*Source:* Adapted from the American Burn Association.
*Criteria for children have not been established. If in doubt, consult a medical professional.

**Table 11-2 First Aid for Burns**

| Type of Burn | Do . . . | Don't . . . |
|---|---|---|
| First-degree burn (redness, mild swelling, and pain) | Apply cold water and, after cooled, apply aloe vera gel or a body lotion. | Apply butter, oleomargarine, or similar substances. |
| Second-degree burn (deeper injury; blisters develop) | Apply cold water.<br>After cooled, apply antibiotic ointment.<br>Treat for shock. | Break blisters.<br>Remove shreds of tissue.<br>Use a home remedy. |
| Third-degree burn (deeper destruction; skin layers destroyed) | Cover the burn with a sterile cloth to protect it.<br>Treat the victim for shock.<br>Watch for breathing difficulty.<br>Obtain medical attention quickly. | Remove charred clothing that is stuck to the burn.<br>Apply ice.<br>Use a home medication. |
| Chemical burn | Remove chemical by flushing with large quantities of water for at least 20 minutes.<br>Remove surrounding clothing.<br>Quickly obtain medical care. | Apply water under high pressure.<br>Try to neutralize with other chemicals. |

- An electrical injury exists.
- The face, hands, feet, or genitals are burned.
- Child abuse is suspected.
- The surface area of a second-degree burn is greater than 10% of the body surface area.
- The burn is third degree.

## Care for Thermal Burns

Burn care aims to reduce pain, to provide physical protection, and to provide a favorable environment for healing that minimizes the chances of scarring and infection Table 11-2. Because burns can continue to injure tissue for a surprisingly long time, it is critical to stop the burning. If clothing is burning, have the victim roll on the ground using the "stop, drop, and roll" method. Smother the flames with a blanket or douse the victim with water. Stop a person whose clothes are on fire from running, which only fans the flames. The victim should not remain standing, because he or she is more apt to inhale flames. Once the fire is extinguished, remove all hot or smoldering clothing because the burning may continue if the clothing is left on. If possible, remove jewelry because heat may be held near the skin and cause more damage. Swelling could make jewelry difficult to remove later. Monitor the victim's breathing.

**CAUTION**

DO NOT remove clothing stuck to the skin. Cut around the areas where clothing sticks to the skin.

DO NOT pull on stuck clothing; pulling will further damage the skin.

### *Care for First-Degree Burns*

1. Run cold tap water (60° to 77°F [15° to 25°C]) over the area as soon as possible Figure 11-6 or apply a wet, cold cloth to reduce pain. Apply cold until the part is pain free while in and out of the water (usually in 10 minutes, but it may take up to 45 minutes). Cold stops the progression of the burn into deeper tissue. If cold water is unavailable, use any cold, drinkable liquid to reduce the temperature of the burned skin.
2. Give ibuprofen to relieve pain and inflammation.
3. Have the victim drink as much water as possible without becoming nauseous.
4. After the burn has been cooled, apply an aloe vera gel or an inexpensive skin moisturizer lotion to keep the skin moistened and to reduce itching and peeling. Use a lotion that does not have alcohols or strong fragrances. Lotions with

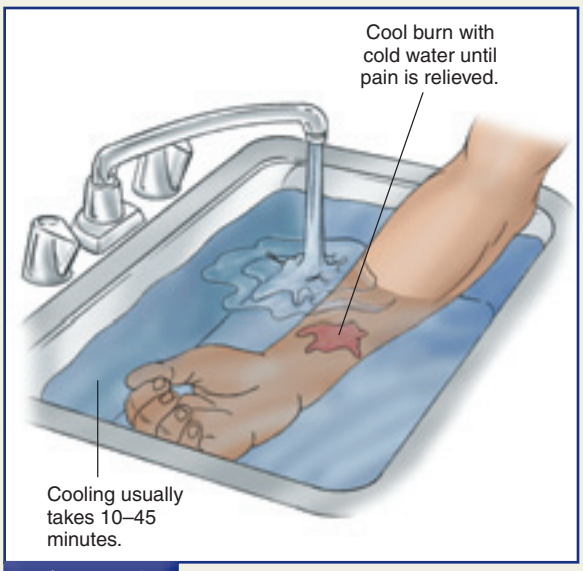



**Figure 11-6**

Immerse the burn. Cool burn with cold water until pain is relieved. Cooling usually takes 10–45 minutes.

glycerin and mineral oil are best. Aloe vera has antimicrobial and anti-inflammatory properties and is a mild analgesic.

5. Keep a burned arm or leg raised to reduce swelling and pain.

**CAUTION**

DO NOT apply cold over a large burn for a prolonged time because it can produce hypothermia.

DO NOT use an ice pack or ice water unless it is the only source of cold available. If you must use it, apply it for only 10 to 15 minutes.

DO NOT apply grease, butter, cream, or a home remedy. Such coatings are unsterile and can lead to infection. They also can seal in heat, causing further damage.

DO NOT cover a first-degree burn.

### *Care for Small Second-Degree Burns (<10% BSA)*

1. Run cold tap water (60° to 77°F [15° to 25°C]) over the area as soon as possible or apply a wet, cold cloth to reduce pain. Apply cold until the part is pain free while in and out of the water (usually in 10 minutes, but it may take up to 45 minutes). Cold stops the progression of the burn into deeper tissue. If cold water is unavailable, use any cold, drinkable liquid to reduce the temperature of the burned skin.
2. Give ibuprofen to relieve pain and inflammation.
3. Have the victim drink as much water as possible without becoming nauseated.
4. After a burn has been cooled, apply a thin layer of an antibiotic ointment. Topical antibiotic therapy does not sterilize a wound, but it decreases the number of bacteria to a level that can be controlled by the body's defense mechanisms and prevents the entrance of bacteria. Physicians may prescribe a silver-based antibiotic, which is the agent of choice for burn wounds.
5. Cover the burn with a dry, nonsticking, sterile dressing or a clean cloth. Covering the burn reduces the amount of pain by keeping air from the exposed nerve endings. The main purpose of a dressing over a burn is to keep the burn clean, prevent evaporative moisture loss, and reduce pain. If fingers or toes have been burned, place dry dressings between them and seek medical care.
6. Seek medical care for second-degree burns covering more than 10% of the BSA.

**Q&A**

**When cooling a burn, how cold should the water be and how long should cooling last?**

Immediately cool the burn with cold—but not ice-cold—water. Cooling of burns has many beneficial effects, including pain relief, reduced swelling, reduced depth of the burn, and more rapid healing. Although cooling should begin as soon as possible, delayed cooling may still be beneficial. Studies recommend various temperatures and durations. Optimal healing involves temperatures of 60°F to 77°F (20°C to 25°C). Other studies have water temperature ranging from 50°F to 59°F (10°C to 15°C). Typical cold water available in North American homes ranges from 50°F to 59°F (10°C to 15°C).

The duration of cooling is controversial, but cooling should continue at least until the pain is relieved and probably for a total duration of 15 to 30 minutes. Whenever using any cold water for a burn, monitor for hypothermia (ie, shivering and cold skin on unburned areas). Although brief exposure to ice or ice water may be beneficial, prolonged cooling may cause additional injury.

**FYI**

**Burned Tongue**

A few grains of sugar sprinkled on the tongue can relieve the misery of a tongue burned by hot food or drink. Repeat as often as needed. Sucking on ice chips or a popsicle can cool the burn.

**CAUTION**

DO NOT cool more than 20% of an adult's body surface area (10% for a child) except to extinguish flames.

*Care for Large Second-Degree Burns (>10% BSA)*

1. Cold can be applied if you monitor the victim for hypothermia (eg, shivering, cold skin on unburned areas).
2. Follow steps 2 and 3 for first-degree and small second-degree burn care.
3. Cover the burn with a dry, nonstick, sterile, or clean dressing.
4. Treat for shock.
5. Seek medical care.

*Care for Third-Degree Burns*

1. Cover the burn with a dry, nonsticking, sterile dressing or a clean cloth.
2. Treat the victim for shock and keep the victim warm with a clean sheet or blanket.
3. Seek medical care.

**CAUTION**

DO NOT break any blisters. Intact blisters serve as excellent burn dressings. Cover a ruptured blister with an antibiotic ointment and a dry, sterile dressing.

DO NOT use plastic as a dressing because it will trap moisture and provide a good place for bacteria to grow (its only advantage is that it will not stick to the burn).

## Later Thermal Burn Care

For after-thermal burn care, follow a physician's recommendations, if a physician has been consulted (many burns are never seen by a doctor). The following suggestions may apply:

- Wash hands thoroughly before changing any dressing.
- Leave unbroken blisters intact.
- Change dressings once or twice a day unless a physician instructs otherwise.

To change a dressing:

1. Remove the old dressing. If a dressing sticks, soak it off with cool, clean water.
2. Cleanse the area gently with mild soap and water.
3. Pat the area dry with a clean cloth.
4. Apply a thin layer of antibiotic ointment to the burn.
5. Apply a nonsticking sterile dressing.

Watch for signs of infection. Call a physician if any of these appear:

- Increased redness, pain, tenderness, swelling, or red streaks near the burn
- Pus
- Elevated temperature (fever)

Keep the area and dressing as clean and dry as possible. Elevate the burned area, if possible, for the first 24 hours. Give pain medication, if necessary.

**Q&A**

**Why does it take several days for a physician to determine how deep a severe burn injury goes?**

Because of blisters, having clothing melted into the skin, or being covered with dirt, it can take several days of wound cleaning before proper assessment can be done by a physician.

## Scald Burns

Scald burns are the result of contact with hot liquids. Scald burns can be divided into two types: immersion burns and spill burns. An *immersion burn* results when an area of the body is fully immersed in a hot liquid. It generally has definite demarcations between healthy and injured tissue. This type of burn tends to be deep and is often full thickness. This type of injury is generally caused by abuse and is seen most often in children.

A *spill burn* occurs when a liquid spills, drops, or is thrown on a person. The pattern of this type of burn

generally is irregular and may be scattered across large body areas. A spill burn usually is not as deep as an immersion burn.

Neglect and lack of supervision of children in the kitchen and the bathtub are frequent causes of spill burns. Scalds in adults occur more often in the elderly population, who generally have decreased sensation. As a result, many elderly victims are scalded in the bath.

## Sunburn

In the United States, about one third of adults and about two thirds of children have a sunburn each summer. Sunburn is the skin's response to the trauma of ultraviolet (UV) radiation that results mainly from exposure to UVB radiation or, rarely, to UVA radiation. Sunburn may be the most common burn sustained by humans, and probably all persons have had one at some time **Figure 11-7**. True sunburn reaction begins 2 to 8 hours after UV radiation exposure. The amount of UV light the skin has received is difficult to gauge accurately. Not until after exposure (4 to 12 hours later) does the redness, tenderness, and discomfort of sunburned skin confirm the overexposure. Painful blistering and swelling peak about 24 hours later.

Sunburn results in first- or second-degree burns. A third-degree burn can occur from a sunburn, but it is rare. The redness of a sunburn is caused by the dilation of the small blood vessels. Blister formation comes from plasma leakage.

**Figure 11-7**

Sunburn.

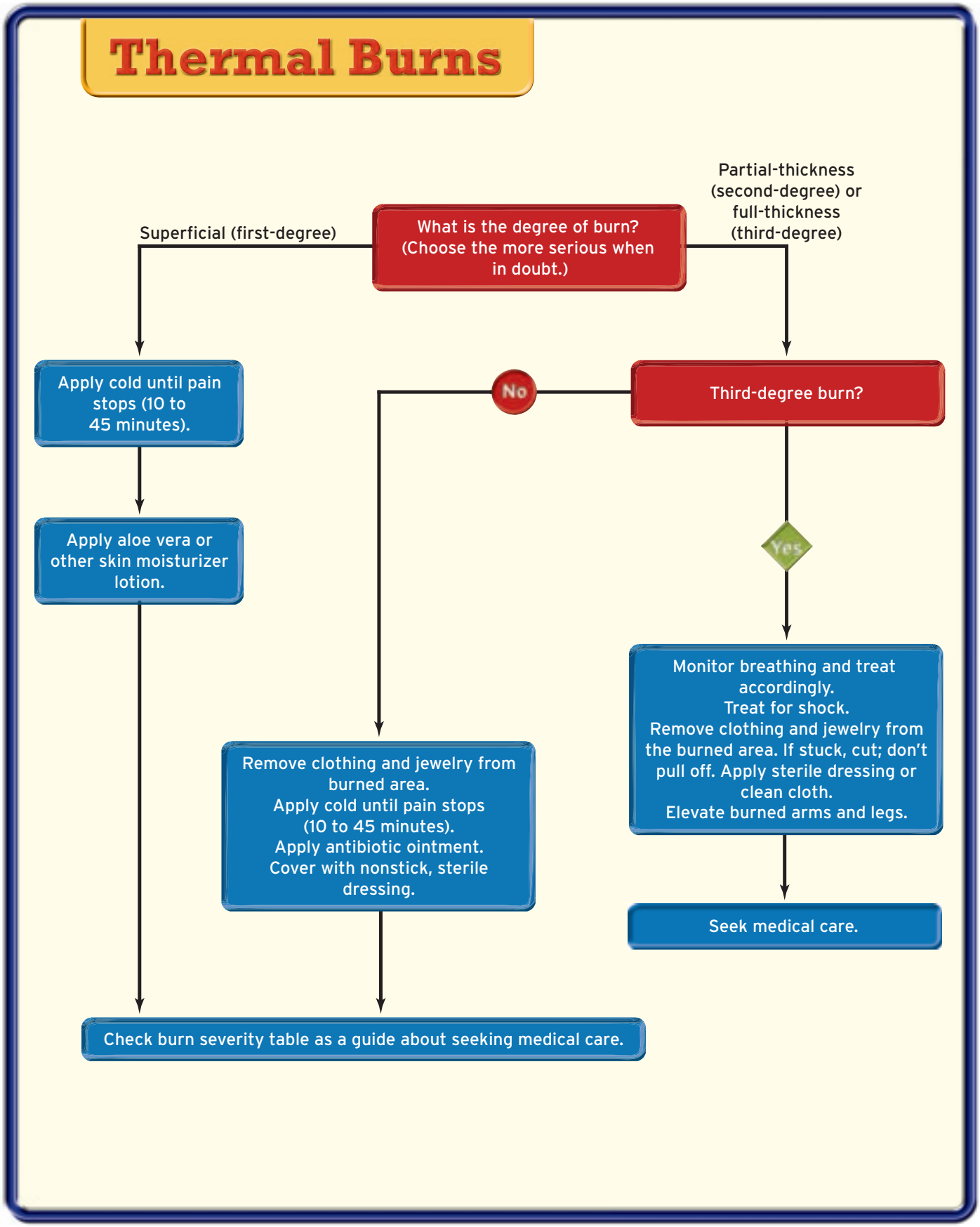
Human skin displays marked differences in its response to UV radiation exposure. Some people always burn and never tan, while others rarely experience a painful sunburn. The variability is largely attributed to the degree of pigmentation (melanin) that the skin contains. Darker-hued people generally are more resistant to the sun's rays than are those with light complexions, but all human beings eventually will burn if exposed to enough UVB. Other variables that contribute to individual sensitivity include the area of the body exposed, the underlying condition of the skin, the degree of tanning, and the role of various photosensitizing medicines.

Various skin types respond differently to UV light:

- Type I skin always burns easily and never tans. A type I person normally has blue eyes, red hair, and freckles.
- Type II skin burns easily, tans slightly.
- Type III skin sometimes burns, but always tans gradually and moderately.
- Type IV skin minimally burns and always tans well. Examples of people with type IV skin are people of Hispanic or Asian descent.
- Type V skin rarely burns and tans deeply. Examples of people with type V skin are Middle Easterners and Indians (heavily pigmented).
- Type VI skin does not burn (although it can burn or peel with significant exposure). An example of people with type VI skin is people of African descent (deeply pigmented).

### *Care for Sunburns*

1. Cool compresses for up to 45 minutes are quite soothing to sunburned skin. Frequent cool showers or soaking in a tub may provide remarkable relief. Some experts advise against the use of topical analgesics, sprays, or lotions, especially those containing benzocaine. Benzocaine may sensitize the skin, resulting in contact dermatitis that compounds the original problem. Topical anesthetic sprays or lotions may provide temporary relief, but they are expensive and generally ineffective. Over-the-counter (OTC) analgesics such as ibuprofen should suffice in most cases because they reduce pain and inflammation. Drinking lots of water is also suggested.
2. First- and second-degree sunburns can be quite painful. When a large area of skin is involved,



the person may feel ill and have chills and fever. After the pain of a first-degree sunburn has subsided, the use of aloe vera or another body lotion can keep the skin moist. Do not use butter or petroleum jelly.

**FYI**

Windburn resembles a first-degree sunburn. A greasy sunscreen can be used to prevent and treat it.

**CAUTION**

DO NOT use topical OTC burn ointments or sprays or anesthetic sprays because:

- Some products may cause allergic reactions.
- Most do not contain enough benzocaine or lidocaine to suppress pain.
- The duration of any possible relief is relatively short (30 to 40 minutes). More than three or four applications per day of products containing local anesthetics is discouraged because toxic effects can occur if the agents are used too frequently.
- They seal in the heat.
- They are expensive.

### *Sunburn Aftercare*

For aftercare of a second-degree sunburn, apply antibiotic (available as an OTC medication) ointment in a thin layer. It is inexpensive, antimicrobial, widely available, easily applied, and adheres even to exposed areas such as the face. If blisters break, gently wash the area twice daily with soap and water and then cover with an antibiotic ointment and sterile gauze to prevent infection. If the burn becomes infected, seek medical care. If the eyes are affected, seek medical care.

## Chemical Burns

A *chemical burn* is the result of an acid or an alkali substance touching the skin **Figure 11-8**. Because chemicals continue to "burn" as long as they are in contact with the skin, they should be removed from the victim as rapidly as possible.

First aid is the same for all chemical burns. Alkalis such as drain cleaners cause more serious burns than acids such as battery acid because they penetrate deeper and remain active longer. Organic compounds such as petroleum products are also capable of burning.

**FYI**

**Sunburn Prevention**

The best protection against the damaging effects of UV radiation is to limit exposure to sunlight. That is done most easily with protective clothing, such as hats, long-sleeved shirts, and long pants. Wet, white cotton will transmit UV radiation, so people can be sunburned while wearing such clothing. People should avoid prolonged exposure during times of the day when radiation is most intense (usually between 10 AM and 2 PM) and apply effective sunscreens.

Sunscreens are readily available and offer the best protection against sunburn, skin cancers, and other long-term skin injury. The proper use of sunscreens will protect a person from the harmful effects of the sun. Sunscreens must be applied correctly, which generally means applying the sunscreen at least 20 minutes before sun exposure, so it will "bond" to your skin, and reapplying it every few hours. Use waterproof sunscreen if you sweat a lot or if you will be in and out of the water. It is important to note that sunscreens do not promote tanning; they do, however, allow the user to tan gradually without serious burning.

To help consumers select an effective sunscreen, the system of rating products by the *skin protection factor (SPF)* has been developed. The higher the SPF number, the greater the protection against sunburn. However, a sunscreen that has an SPF of 30 is not twice as good as one with an SPF of 15. An SPF of 15 blocks out 95% of the most harmful rays; a sunscreen with an SPF of 30 gives you only another 3% of protection. Because most people usually use only half the amount of sunscreen that is effective, using a sunscreen with an SPF of 15 probably affords protection equivalent to a sunscreen with an SPF of 7.5. If they use a sunscreen with a 30 SPF, they are probably getting the protection of a 15 SPF sunscreen.

Many "suntan lotions" have no sunscreen effect and serve only to keep the skin moist. Products such as baby oil and cocoa butter offer no protection against serious sunburn and may actually enhance burning.

Figure 11-8

Chemical burn from sulfuric acid.

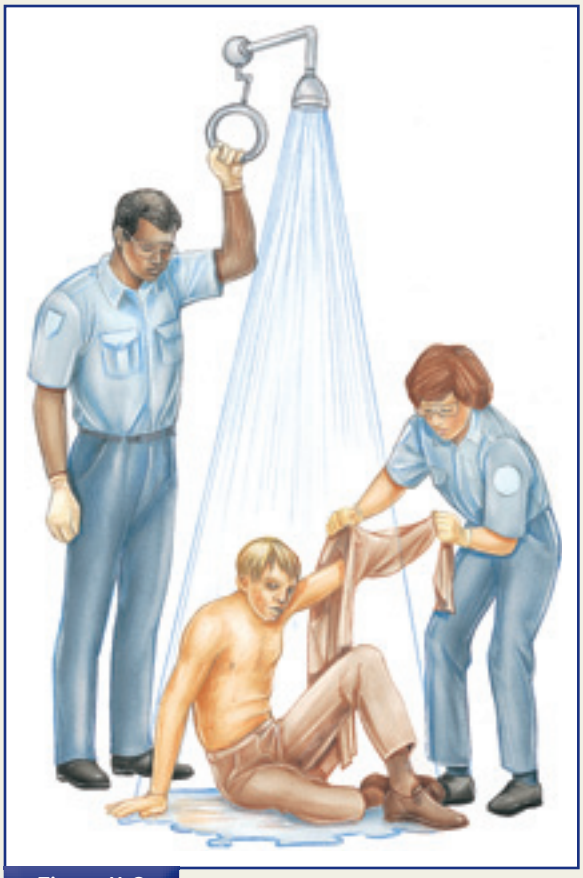


Figure 11-9

Flushing a chemical burn.

## Q&A

**How can you determine how deep a burn is?**

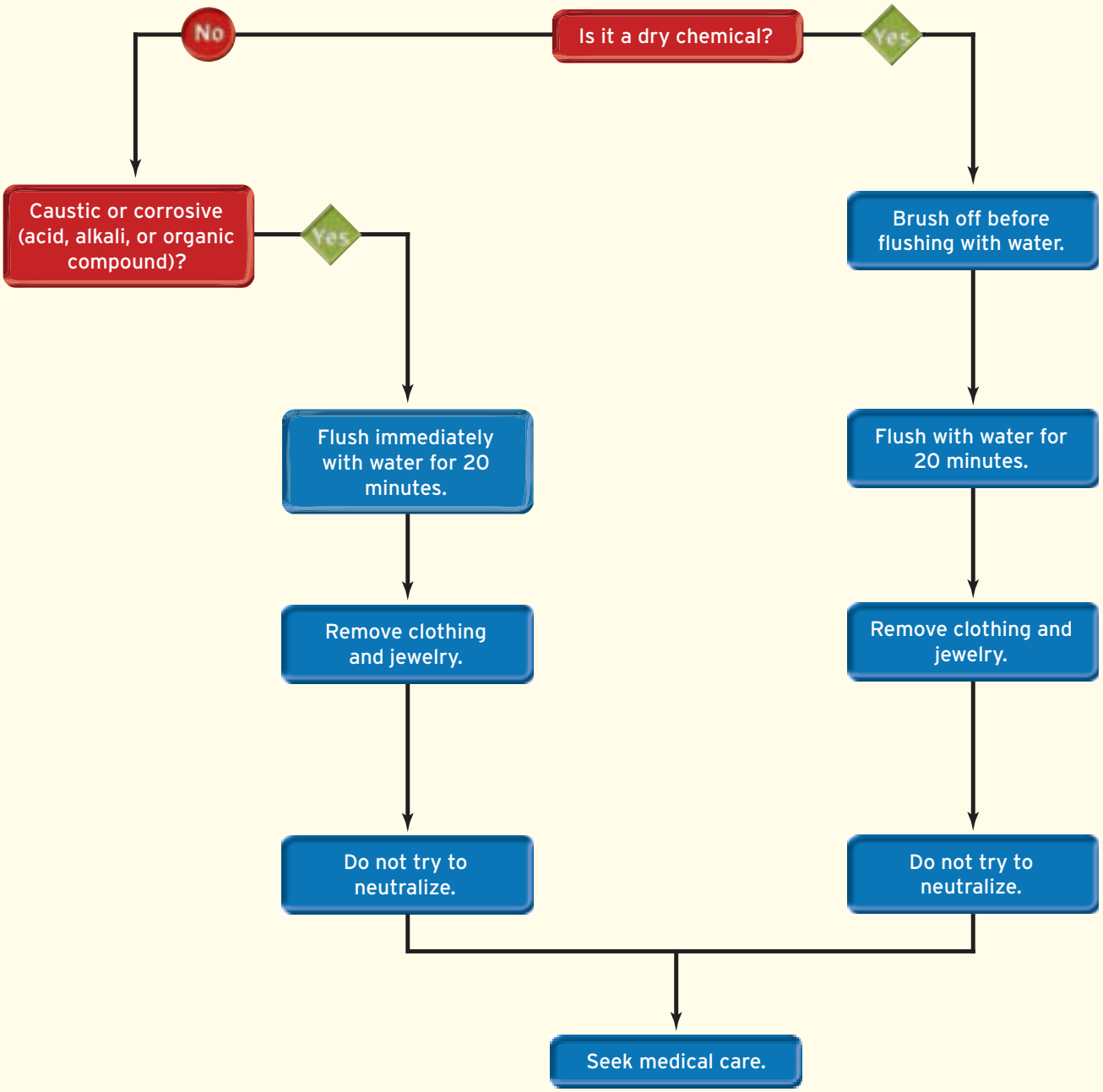
There are two layers of skin: the epidermis and the dermis. The epidermis, the outer layer of skin, serves primarily as a barrier between the body and the environment. The dermis has blood vessels and contains nerves, sweat glands, sebaceous glands, and hair roots.

The individual layers of skin are not visible to the naked eye, so when determining depth of a burn, it is helpful to remember that the dermis is the layer that will bleed. Full-thickness burns do not bleed because the blood vessels have been destroyed.

### Care for Chemical Burns

1. Immediately remove the chemical by flushing the body portion with water Figure 11-9. If available, use a hose or a shower. Brush dry powder chemicals from the skin before flushing. Water may activate a dry chemical and cause more damage to the skin. Take standard precautions to protect yourself from exposure to the chemical.
2. Remove the victim's contaminated clothing and jewelry while flushing with water. Clothing can hold chemicals, allowing them to continue to burn as long as they are in contact with the skin.
3. Flush for 20 minutes or longer. Let the victim wash with a mild soap before a final rinse. Washing with large amounts of water dilutes the chemical concentration and washes it away.
4. Cover the burned area with a dry, sterile dressing or, for large areas, a clean lint-free cloth, such as a pillowcase.
5. If the chemical is in an eye, flood it for at least 20 minutes, using a gentle stream of water.
6. Seek medical care immediately for all chemical burns.

# Chemical Burns



**CAUTION**

DO NOT waste time! A chemical burn is an emergency!

DO NOT apply water under high pressure; it will drive the chemical deeper into the tissue.

DO NOT try to neutralize a chemical even if you know which chemical is involved; heat may be produced, resulting in more damage. Some product labels for neutralizing may be wrong. Save the container or the label for the chemical's name.

## Electrical Burns

Even a mild electrical shock can cause serious internal injuries Figure 11-10. A current of 1,000 volts or more is considered high voltage, but even the 110 volts found in ordinary household current can be deadly. There are three types of electrical injuries: thermal burn (flame), arc burn (flash), and true electrical injury (contact). A *thermal burn* (flame) results when clothing or objects in direct contact with the skin are ignited by an electric current. These injuries are caused by the flames produced by the electric current and not by the passage of the electric current or arc.

An *arc burn* (flash) occurs when electricity jumps, or arcs, from one spot to another and not from the passage of an electric current through the body. Although the duration of the flash may be brief, it usually causes extensive superficial injuries.

A true *electrical injury* (contact) happens when an electric current passes directly through the body. This type of injury is characterized by an entrance wound and an exit wound. The important factor with this type of injury is that the surface injury may be just the tip of the iceberg. High-voltage electric currents passing through the body may disrupt the normal heart rhythm and cause cardiac arrest, internal burns, and other injuries.

During an electrical shock, electricity enters the body at the point of contact and travels along the path of least resistance (nerves and blood vessels). The major damage occurs inside the body—the entrance burn may appear small. Usually, the electricity exits where the body is touching a surface or is in contact with a ground (for example, a metal object). The exit wound can be extensive. Sometimes, a victim has more than one exit site.

Figure 11-10

Electrical burns. **A.** Exit wound on a foot. **B.** Electrical burn caused by chewing through an electrical cord.

### Care for Electrical Burns

1. Make sure the area is safe. Unplug, disconnect, or turn off the power. If that is impossible, call 9-1-1 for help. Never touch an energized wire, object, or victim yourself.
2. Check breathing and, if absent, begin CPR.
3. If the victim fell, check for a spinal injury.
4. Treat the victim for shock.
5. Place dry, sterile dressings on all burn wounds.
6. Place blankets under and over the victim.
7. Seek medical care immediately. Electrical injuries may require treatment in a burn center.

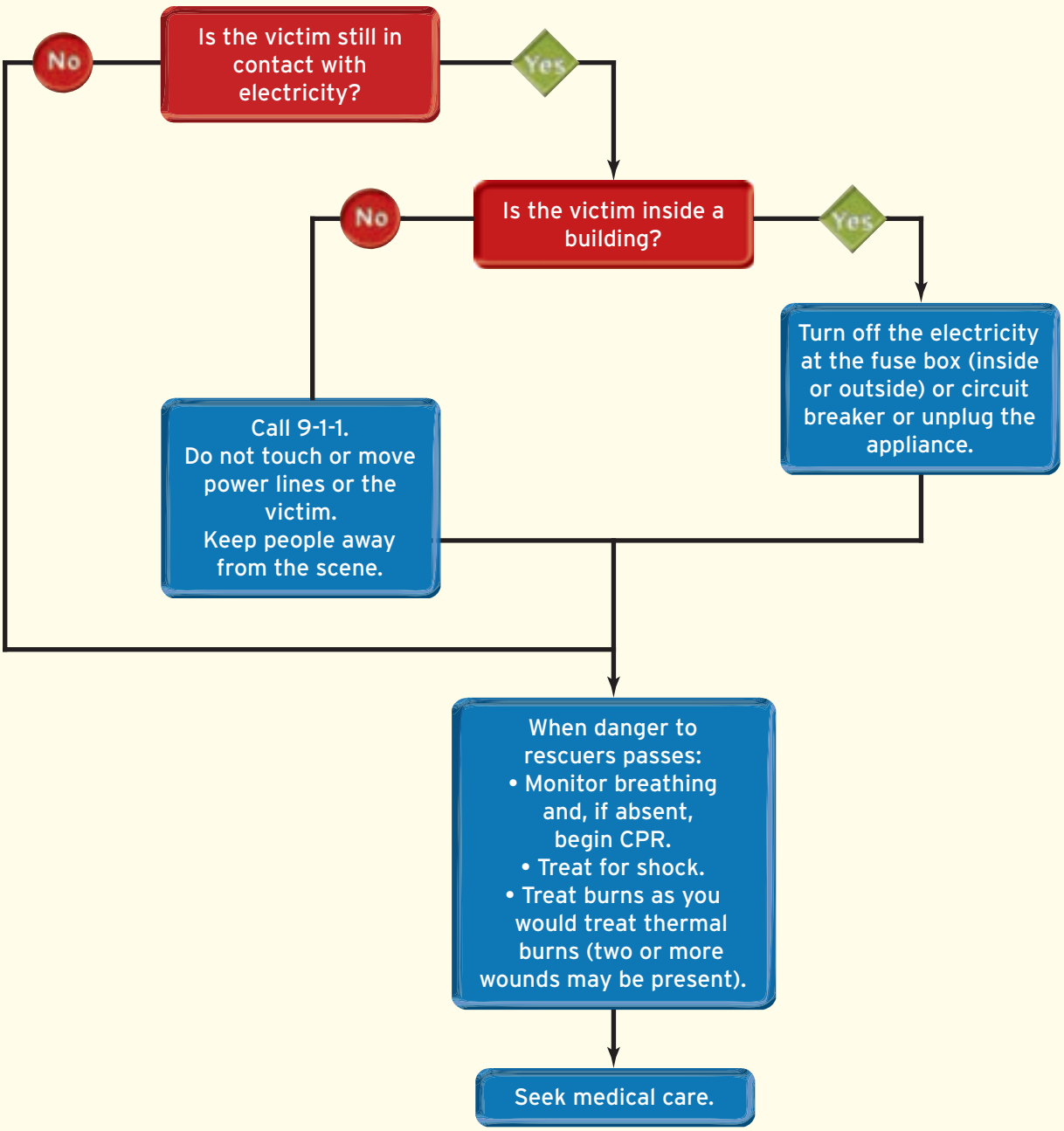
### Contact With an Outdoor Power Line

If the electrical shock is from contact with a downed power line, the power must be turned off before a rescuer approaches anyone who may be in contact with the wire. If a power line falls across a car containing a person, tell the person to stay in the car until the power can be shut off. The only exception is if fire threatens the car. In that case, tell the victim to jump out of the car without making contact with the car or the wire.

If you feel a tingling sensation in your legs and lower body as you approach a victim, stop. The sensation signals that you are on energized ground and that an electric current is entering through one foot, passing through your lower body, and leaving through the other foot. Raise one foot off the ground, turn around, and hop to a safe place.

If you can safely reach the victim, do not attempt to move any wires, even with wooden poles, tools with wood handles, or tree branches. Wood can conduct electricity and the rescuer will be electrocuted. Do *not* attempt to move downed wires unless you are trained and equipped with tools able to handle the

# Electrical Burns



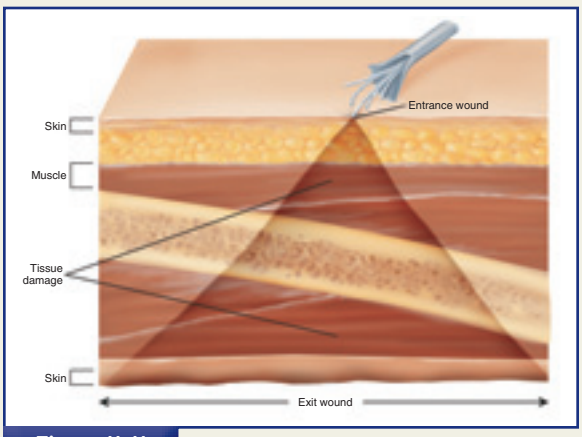



**Figure 11-11**

The external signs of an electrical burn may be deceiving. The entrance wound may be a small burn, while the damage to deeper tissue may be massive.

high voltage. Wait until trained personnel with the proper equipment can cut the wires or disconnect them. Prevent bystanders from entering the danger area.

### Contact Inside Buildings

Most electrical burns that occur indoors are caused by faulty electrical equipment or careless use of electrical appliances. Turn off the electricity at the circuit breaker, fuse box, or outside switch box, or unplug the appliance if the plug is undamaged. Do not touch the appliance or the victim until the current is off.

Once there is no danger to rescuers, first aid can begin. Electric current flows quickly into the body's tissues and then exits. The surface injuries of the skin involve small surface areas (entrance and exit points); the major damage occurs deep under the skin **Figure 11-11**. See Chapter 24, *Wilderness First Aid,* for lightning burns and their care.

## Emergency Care Wrap-up

| Condition | What to Look For | What to Do |
|---|---|---|
| Thermal (Heat) Burns | **First-degree burn (superficial)**<br>• Redness<br>• Mild swelling<br>• Pain | 1. Cool the burn with cold water.<br>2. Apply aloe vera gel or a skin moisturizer.<br>3. If available, give an OTC medication to reduce pain and swelling. |
| | **Second-degree burn (partial thickness)**<br>• Blisters<br>• Swelling<br>• Pain<br>• Weeping of fluid | 1. Cool burn with cold water and monitor victims with large, second-degree burns for hypothermia.<br>2. Apply antibiotic ointment.<br>3. Cover with a dry, nonstick sterile dressing.<br>4. If available, give an OTC medication to reduce pain and swelling.<br>5. Seek medical care. |
| | **Third-degree burn (full thickness)**<br>• Dry, leathery skin<br>• Gray or charred skin | 1. Monitor breathing and provide care as needed.<br>2. Cover burn with a dry, nonstick sterile, or clean dressing.<br>3. Treat for shock.<br>4. Seek medical care. |
| Chemical Burns | • Stinging pain | 1. Brush dry chemicals off skin.<br>2. Flush with a large amount of water for 20 minutes (gentle water flow).<br>3. Remove the victim's contaminated clothing and jewelry while flushing.<br>4. Cover the area with a dry, sterile, or clean dressing.<br>5. Seek medical care. |
| Electrical Burns | • Possible third-degree burn with entrance and exit wounds | 1. Safety first! Unplug, disconnect, or turn off the electricity.<br>2. Open the airway, check breathing, and provide care as needed.<br>3. Care for burns as you would a third-degree burn.<br>4. Seek medical care. |

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## Ready for Review

- Burns occur in every age group; across all socioeconomic levels; at home and in the workplace; and in urban, suburban, and rural settings.
- Burn injuries can be classified as thermal, chemical, or electrical.
- Treatment depends on the depth of burns.
- A chemical burn is the result of a caustic or corrosive substance touching the skin.
- There are three types of electrical injuries: thermal burn (flame), arc burn (flash), and true electrical injury (contact).

## Vital Vocabulary

**burns** Injuries in which soft tissue receives more energy than it can absorb from thermal heat, chemicals, or electricity.

**chemical burns** Damage caused to the skin by chemicals.

**electrical burns** Injury caused from contact with electric current.

**first-degree (superficial) burns** Burns affecting only the epidermis. Characterized by skin that is red but not blistered or burned through.

**second-degree (partial-thickness) burns** Burns affecting the epidermis and some portion of the dermis but not the subcutaneous tissue. Characterized by blisters and skin that is white to red and moist.

**thermal (heat) burns** Damage to the skin caused by contact with hot objects, flammable vapor, steam, hot liquid, or flames.

**third-degree (full-thickness) burns** Burns that affect all skin layers and may affect the subcutaneous layers, muscle, bone, and internal organs, leaving the area dry, leathery, and white, dark brown, or charred.

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## Assessment in Action

After a long, hot day at the water park, your friend complains of severe sunburn on his back and shoulders. He failed to apply sunscreen while at the water park. Blisters have formed, and your friend refuses to sit up in a chair and complains of severe pain.

***Directions:*** Circle Yes if you agree with the statement; circle No if you disagree.

Yes No **1.** The blisters and pain are signs that this is a first-degree burn.

Yes No **2.** You should break the blisters to relieve pressure and clean the burn.

Yes No **3.** Cool compresses can be used to relieve pain.

Yes No **4.** You can apply antibiotic ointment and aloe vera to keep the skin moist.

Yes No **5.** This person does not need medical care.

## Check Your Knowledge

***Directions:*** Circle Yes if you agree with the statement; circle No if you disagree.

Yes No **1.** Victims of a burn should immediately drink water.

Yes No **2.** Petroleum jelly can be applied over a burn.

Yes No **3.** The rule of the hand can help determine the size of a burned area.

Yes No **4.** Neutralize an acid on the skin by using baking soda.

Yes No **5.** Use a large amount of water to flush chemicals off the body.

Yes No **6.** Brush a dry chemical off the skin before flushing with water.

Yes No **7.** When someone gets electrocuted, there can be two burn wounds: entrance and exit.

Yes No **8.** When a victim is in contact with a power line, use a tree branch to remove the wires.

Yes No **9.** Ibuprofen helps relieve pain and swelling.

Yes No **10.** Cold water can be used, in moderation, on any burn of any size.