BURNS

Their Evaluation and Treatment in Urgent Care

Urgent message: Most burn injuries can be handled in an outpatient setting—if they are classified accurately, treated appropriately, and referred to a regional burn center when indicated.

TRACEY QUAIL DAVIDOFF, MD

Introduction

A "burn" is defined as a traumatic, thermal injury to the skin and deeper structures. Some or all of the cells of the skin can be destroyed not only by heat but also by cold, chemicals, electricity, or radiation.

Burns are the third-leading cause of accidental death in the United States, and more than 1 million burn injuries are incurred in the US each year (**Table 1**). Burns are most common in males 18-35 years of age. Recent advances in burn care have dramatically decreased mortality to fewer than 10% of patients admitted to burn units. Mortality is twofold greater in women.

The most common type of burn in children is from a scald injury, caused, for example, by bath water that is too hot or boiling liquid from a pot on a stove.

In adults, the most common cause of burns is from direct flame or contact with a hot solid object such as a stove or oven. Hot liquids and steam also account for a fair amount of burns in adults.

Types of Burns

Four types of burns are commonly seen in the urgent care center: thermal, chemical, electrical, and radiation.

Tracey Quail Davidoff is a staff physician at Excelcare Medical Urgent Care and Urgent Care by Lifetime Health, both in Rochester, New York. She is board-certified in internal medicine and worked for 18 years as an emergency physician before switching to urgent care 4 years ago.

Table 1. How Common Are Burn Injuries?

Burn injuries receiving medical treatment: 450,000
Includes visits to hospital emergency departments, hospital outpatient clinics, freestanding urgent care centers, and private physician offices.

Fire and burn deaths per year: 3,500
Includes deaths from residential fires, motor vehicle and plane crashes, and contact with electricity, chemicals, or hot liquids and substances.

Hospitalizations for burn injury: 45,000
About 55% of burn patients were admitted to 125 hospitals with specialized facilities for burn care, a percentage that has increased steadily in recent decades.

Statistics on admission to burn centers, 2000-2009
- Survival rate: 94.8%
- Gender: 70% male, 30% female
- Ethnicity: 63% white, 17% African American, 14% Hispanic, 6% other
- Admission cause: 42% fire, 31% scald, 9% contact, 4% electrical, 3% chemical, 11% other
- Place of occurrence: 66% home, 10% occupational, 8% highway/street, 16% other

Adapted from the American Burn Association Burn Incidence Fact Sheet. Available at *www.ameriburn.org*.

Thermal burns
Thermal burns occur from heat, either as a direct flame, contact with a solid object, steam, or hot liquids such as water or oils. The depth of injury is related to the contact temperature, duration of contact, and the thickness of the skin. Treatment and prognosis are related to the depth of the burn.

Chemical burns
Injury from chemicals is caused by a wide range of caustic reactions, including alteration of pH (eg, from acid or alkali burns), disruption of cellular membranes, and direct toxic effects on the metabolic processes of cells. Some examples include wet cement, hydrofluoric acid in tire cleaner, gasoline, phenols, and hydrocarbons.

The nature of the agent, as well as the length of contact, contribute to injury severity. This information is essential to the proper evaluation and care of chemical burns. For example, contact with acid generally produces tissue coagulation, whereas alkaline burns generate colliquation necrosis.

Systemic absorption of the burn-causing chemical is also a concern in chemical exposures. As a rule, for most chemical burns, exposure and reaction should be limited by dilution. This is accomplished by continuous irrigation of the burn with tap water or saline.

Most chemical exposures occur in the workplace or are household-related. Typically, the packaging of the chemical is brought in with the patient. If information regarding the chemical is not available, quickly searching the Internet or contacting your local poison control center may be helpful in determining the proper course of action.

Once the chemical has been eradicated, the resulting burn is treated in the same fashion as a thermal burn.

Electrical burns
Electrical energy is transformed into thermal energy as the current passes through human tissue. This causes cell damage and death. The magnitude of the injury depends on the pathway of current, resistance to current, and the strength and duration of current flow.

After an electric shock, patients may have electrical "entrance" and "exit" wounds. These usually occur on the hands, feet, or skull, or on oral mucous membranes, especially in children.

Electrical burns are usually painless white, gray, or yellow depressions in the skin. They can be deceiving, however, as a small wound may represent serious underlying injury to subcutaneous structures. Compartment syndromes may occur.

Patients with serious electrical burns are at risk for rhabdomyolysis, renal failure, and cardiac conduction abnormalities. For this reason, evaluation in the hospital for any patient with an electric shock injury is warranted.

Radiation burns
The most common form of radiation burn is exposure to ultraviolet light, or sunburn. Higher amounts of radiation can cause deep internal burns; ultimately, alteration of DNA can cause cancer. Sunburn is generally treated as a first-degree, superficial, thermal burn. More serious radiation burns are beyond the scope of this article.

Evaluation
The initial approach to any burn patient should start with the ABCs. Concerns about burns to the upper airway, smoke inhalation (**Table 2**), and poisoning from toxic gases from burning plastics such as cyanide should always be considered. Hot and burned clothing should be re-

Table 2. Common Signs of Significant Smoke Inhalation Injury

- Persistent cough, stridor, or wheezing
- Hoarseness
- Deep facial or circumferential neck burns
- Nares with inflammation or singed hair
- Carbonaceous sputum or burnt matter in the mouth or nose
- Blistering or edema of the oropharynx
- Depressed mental status, including evidence of drug or alcohol use
- Respiratory distress
- Hypoxia or hypercapnia

moved. Other injuries should be assessed. If any doubt exists as to the severity of burns or injury, or if respiratory status is in question, EMS should be called and the patient transferred to the nearest hospital.

Carboxyhemoglobin levels should also be obtained for any patient with suspected smoke inhalation; such patients should be maintained on 100% oxygen until levels can be determined.

Flash burns, such as those that might be caused by a gas grill or oven pilot light, often harm the face but rarely involve the airway, unlike severe burns from prolonged heat exposure associated with smoke inhalation.

Fluid resuscitation should also be instituted as soon as possible with any moderate burns, as fluid losses and shifts may be massive. Although usually not a concern in most urgent care centers, rural areas or areas that may have a long transport time to the hospital may see patients who require fluid resuscitation in the urgent care center. Crystalloid, such as normal saline or lactated ringers, is preferred. Calculation of amounts of fluid is beyond the scope of this article but can be found in most emergency medicine textbooks (see *Resources* on page 20).

Burns are often associated with other injuries, such as are seen in motor vehicle crashes, blast injuries, falls from heights, and assaults. Clinicians should maintain a high index of suspicion to rule out associated injuries.

Major traumas, such as long-bone fractures and injuries of abuse or neglect, need to be considered in the evaluation of the burn patient.

Burn Classification and Treatment

The purpose of classifying burns is to determine the best form of treatment and the prognosis, as well as whether evaluation and/or transfer to a burn center is warranted. Due to variable skin thicknesses and variation in exposures, burns may have multiple areas of varying depths, which may make classification difficult (**Tables 3** and **4**).

Furthermore, it may be several days or even weeks before the extent of injury has fully developed. Thin skin on the forearms, medial thighs, perineum, and ears may sustain deeper injuries than initially predicted. Also, children under 5 and adults over 50 years of age may have thinner skin and therefore more serious injuries than expected.

Figure 1. Superficial Burn

Superficial burn due to sunburn.

Traditionally, burns were classified into three degrees, but a newer, more widely accepted classification system based on depth of injury is now used to determine prognosis and disposition of the burn patient.

Superficial burns

Superficial burns involve only the epidermal layer of skin. They do not blister but are very painful, dry, and red, and will blanch with pressure. The classic superficial burn is sunburn **(Figure 1)**. Redness is apparent within two hours of burning and is maximal within 12 hours. In two to three days, the redness and pain begin to subside; on day 4 or 5, the epithelium peels away from the newly healed epidermis.

Superficial burns heal without scarring. Treatment is designed to improve comfort and is not required for actual healing. Topical treatment may include aloe, cool compresses with water, nonfat milk, or Burow's solution. NSAIDs such as ibuprofen or naproxen may decrease pain and inflammation. Severe cases may respond to prednisone 1 mg/kg/day for three days. Narcotic pain medication may also be of benefit.

"Sun poisoning" is a syndrome of severe widespread sunburn associated with nausea, vomiting, and dizziness. IV fluids may be required in these cases. Local anesthetic containing topical preparations should be avoided; they are generally ineffective and may cause sensitization to the ingredients. Patients should be instructed to avoid sun exposure for three weeks. Patients should be

Table 3. Burn Classification

Burn Type	Minor	Moderate	Major
Criteria	• <10% TBSA* in adults • <5% TBSA in children or elderly patients • <2% full-thickness burns	• 10%-20% TBSA in adults • 5%-10% TBSA in children • 2%-5% full-thickness burns • High-voltage injury • Suspected inhalation injury • Circumferential burn • Medical problem predisposing to infection	• >20% TBSA in adults • >10% TBSA in children • >5% full-thickness burns • High-voltage burns • Known inhalation injury • Any significant burns to face, eyes, ears, genitalia, or joints • Significant associated injuries (major fracture or other major trauma)
Disposition	Outpatient	Admit to hospital	Admit to burn center

*TBSA = total body surface area

Table 4. Burn Assessment

Degree	Depth	Cause	Appearance	Sensation	Healing Time
First	Superficial	• Ultraviolet exposure (sunburn) • Very short flash	• Dry, red • Blanches with pressure	Painful	3-6 days
Second	Superficial, partial thickness	• Scald (spill or splash) • Short flash	• Blisters • Moist, red, or weeping • Blanches with pressure	Painful to temperature and air	7-20 days
Second	Deep partial thickness	• Scald (spill) • Flame • Oil • Grease	• Blisters (easily unroofed) • Wet or waxy dry • Variable color (patchy to cheesy white or red) • No blanching with pressure	Perceptive of pressure only	>21 days
Third	Full thickness	• Scald (immersion) • Flame • Steam • Oil • Grease • Chemical • Electrical	• Waxy white, to leathery gray, to charred and black • Dry and inelastic • No blanching with pressure	Deep pressure only	Never if >2% TBSA*
Fourth	Muscle and bone	• Prolonged contact with flame, steam, or electrical • Immersion in oil, grease, or chemical	• No skin remaining • Charred, black, or mummified appearance	Insensate	Never

*TBSA = total body surface area.

Adapted from American Burn Association criteria. Available at *www.ameriburn.org*.

Figure 2. Superficial partial-thickness burn

Superficial partial-thickness burn due to hot liquid. Note the loose tissue on the upper margin due to the break of blister. This can be carefully debrided with tissue scissors to facilitate cleaning and dressing changes. The tissue beneath the blister is healthy and pink.

Figure 3. Deep partial-thickness burn.

Deep superficial-thickness burn several days after injury. Hot liquid such as grease was spilled on the dorsum of the hand. Note the red leathery tissue beneath the broken blister. Although there is a fair amount of redness surrounding the burn, this represents inflammation, not infection.

Figure 4: Mixed-thickness burn.

Mixed-thickness burn consisting of superficial partial-thickness and deep partial-thickness burns due to recent injury. This patient touched a hot object, such as an oven or baking pan. The lower portion shows a recently broken blister with healthy tissue beneath. The upper portion is deeper, with red leathery tissue beneath.

Figure 5. Full-thickness burn.

Full-thickness burn after 8 days. Note the hypertrophic tissue at the margins as the wound granulates inward.

questioned about the use of photosensitizing drugs such as tetracyclines, thiazides, sulfonamides, phenothiazines, sulfonylureas, griseofulvin, vitamin B6, and NSAIDs.

Partial-thickness burns

Partial-thickness burns can be divided into superficial and deep **(Figures 2, 3,** and **4)**. Superficial partial-thickness burns form blisters within 24 hours of injury between the epidermis and dermis. They are painful, red,

may be weeping, and will blanch with pressure. They generally heal in seven to 21 days. If blisters break, a layer of fibrous exudate and debris may accumulate on the surface, which may cause bacterial colonization and delayed healing. Scarring is unusual, but skin changes may take months to dissipate. Pigment changes may occur. There is typically no functional impairment.

Deep partial-thickness burns extend deeper into the dermis, damaging hair follicles and glandular tissues. They are painful to pressure only. Blisters, if present, easily unroof. If absent, the skin may be wet or waxy dry, and may appear cheesy white or red. Blisters do not blanch with pressure. If no infection is present, they should heal without grafting in three to nine days. There is usually hypertrophic scarring, which may cause functional or cosmetic impairment. Grafting may be required in extreme cases.

Full-thickness burns

Full-thickness burns extend through and destroy all layers of the dermis and often injure deeper structures **(Figure 5)**. Burn eschar, the dead and denatured dermis, may compromise the viability of a limb or respiratory function if on the torso or neck. A full-thickness burn is anesthetic. It can vary from waxy white to charred and black in color. The skin may appear and feel leathery. The skin is dry and inelastic and does not blanch with pressure. Hair falls out of the follicles easily. Blisters are not present. The full extent of injury may take several days to develop.

After several days, the wound eschar falls away from the underlying tissue, revealing unhealed granulation tissue. The wound heals by secondary intent, leaving contractures and scarring, which may be severe. Skin-grafting surgery is necessary to prevent deformity and facilitate healing. Full spontaneous healing, except in the smallest burns, is not possible without grafting.

Fourth-degree burns are deep and potentially life-threatening. They extend through to fascia, muscle, and/or bone. Amputation or wide excision of deep tissue is required. The procedure itself may be life-threatening and disfiguring.

Immediate Care

Patients presenting with acute burns should have hot or burned clothing, jewelry, and obvious debris removed immediately to prevent further injury and constriction, and to enable accurate assessment.

Burned areas should be cooled using cool water or saline-soaked gauze. For small and moderate-size burns, cooling may minimize the zone of injury and certainly reduces pain. Although there is no specific time frame, duration of cooling is generally 15-30 minutes.

Ice and freezing should be avoided, as frostbite, hypothermia, and extension of burn damage can occur. Even with cool water, hypothermia may be a concern if more than 10% of total body surface area is burned.

Pain management

Burns hurt! Adequate pain management is essential and should not be withheld. Parenteral narcotics are often required, sometimes in larger doses than are required for other injuries. It may be helpful to medicate patients before cooling, cleaning, and bandaging are undertaken. Regional anesthesia may be considered. Local injection or topical application of an anesthetic should not be used. Adequate narcotic prescriptions should be

When to Refer a Patient to a Regional Burn Center

Just as it is important to know what an urgent care center can do to treat burn injuries, it is equally important to recognize what is beyond the scope of urgent care. A burn patient should be referred to a regional burn center under these conditions:

- Partial-thickness burns greater than 10% total body surface area
- Non-minor burns that involve the face, hands, feet, genitalia, perineum, or major joints
- Full-thickness burns
- Electrical burns, including those caused by lightning
- Chemical burns
- Inhalation injury
- Burn injury in patients with pre-existing medical disorders that could complicate management, prolong recovery, or affect mortality (eg, diabetes, immunosuppression, vascular disorders, etc.)
- Children in whom the reliability of the parents is in doubt
- Burn injury in patients who require special social, emotional, or long-term rehabilitative intervention
- Any patients with associated trauma requiring hospitalization

Most regional burn centers have an 800 number to call if there is a question as to whether a patient is appropriate for referral. Some patients may be more appropriate for outpatient follow-up with a burn clinic; these recommendations and arrangements can be made through a regional burn center. It is best to have the phone number of your designated burn center close at hand in case the need to call is urgent.

A directory of US regional care centers—including number of beds, address, phone, fax, email, and the names of and contact information for center directors—is available at this link: *www.ameriburn.org/BCRDPublic.pdf*. For Canadian regional burn centers, the link is: *www.ameriburn.org/CanadaFinalPub.pdf.*

provided until the patient is able to follow-up. In addition, NSAIDs should be recommended for pain, as their antioxidant, anti-inflammatory, and anti-thromboxane properties may speed healing.

Wound management

All burns should be cleaned by irrigation. Standard recommendations usually include cool saline solution, but recent studies suggest that tap water may be reasonable. Skin disinfectants such as chlorhexidine and povidone/iodine can act as an irritant and inhibit wound healing; as such, they are no longer recommended. Mild soap or antibacterial hand soap may be used, if necessary.

Intact blisters should not be unroofed. In most cases, they should be left in place unless rupture is impending or the blisters are in an area that will likely be traumatized and ruptured (eg, groin, bottom of foot, tip of finger, etc.). Needle aspiration is not recommended due to the increased risk of infection. The skin remaining from broken blisters should be carefully removed.

All partial- and full-thickness burns should have dressings after cleaning. Dressings prevent further trauma and infection, as well as increase patient comfort. Topical antibiotics should be applied to all partial-thickness burns unless the patient is being transferred to a burn center. A thin layer is preferred to copious application.

Traditionally, silver sulfadiazine has been the first-line topical antibiotic. It should not be used on the face or in patients with sulfa allergies, pregnant women, newborns, or breastfeeding mothers.

Bacitracin, triple antibiotics (bacitracin, polymyxin B, neomycin), or polysporin (bacitracin, polymyxin B) may also be used. There are no studies proving the benefit of one over the other. Bacitracin is the least-expensive alternative; it may be preferred for this reason. It has been reported that 7%-13% of Americans are allergic to neomycin[1]; avoidance of triple antibiotics may therefore be prudent. Topical antibiotics should be continued until all wound epithelialization is complete.

A layer of non-adherent gauze should be placed over the antibiotic ointment. Loose strips of fine-mesh gauze (as opposed to continuous wrapping) should then be applied to prevent constriction and provide protective padding and splinting of fingers and toes.

Fingers and toes should each be wrapped individually to prevent maceration of tissue when two burnt surfaces are adjacent. Gauze can be held in place with tubular-net gauze or loose wrapping.

Biologic dressings and bismuth-impregnated petroleum gauze are gaining popularity. At present, however, their use is largely limited to burn centers, where they are used on deeper wounds. They are applied only once and generally do not require changing. These dressings promote lower rates of infection, are more comfortable, require less pain medication, and promote faster healing.

Conversely, biologic and impregnated-gauze dressings are expensive, difficult to apply, and have a narrow time frame for effective application: within six hours of injury. Occasionally, re-application is required if loosening occurs on day 2. The dressing will gradually peel off as wound epithelialization occurs, leaving fresh tissue beneath.

If the wound is deeper than appreciated or if infection occurs, a biologic dressing will be ineffective. In that event, grafting is required.

Resources

While there are numerous resources available for diagnosis and treatment of burn injuries, three texts and one website are especially worthwhile:

- Roberts, JR, Hedges, JR. *Clinical Procedures in Emergency Medicine,* 5th ed. Philadelphia, PA: Saunders; 2009.

Considered one of the best texts on emergency medicine clinical procedures. Chapter 39 is devoted to burn care procedures.

- Tintinalli, JE, Stapczynski J, Ma OJ, et al. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide,* 7th ed. New York, NY: McGraw-Hill; 2010.

With 418 contributors, this is one of most practical and clinically rigorous references for emergency medicine. The chapter on environmental injuries covers thermal burns, chemical burns, electrical injuries, lightning injuries, radiation injuries, and more.

- Buttaravoli, P, *Minor Emergencies: Splinters to Fractures,* 2nd ed. Philadelphia, PA: Mosby Elsevier; 2007.

A quick reference for the hospital or urgent care center, with instructions for handling such common, non-life-threatening emergencies as sunburn, partial-thickness and tar burns, smoke inhalation injury, and more.

- American Burn Association
  www.ameriburn.org

Offers educational materials for providers and patients on electrical, chemical, and non-thermal injuries; wound healing/scar management; burns in the high-risk patient; respiratory/pulmonary injuries and problems associated with burns; rehabilitation/reconstruction; nutrition, infection, and immunology; pain; and psychosocial aspects of burn injury. Includes directories of regional burn centers in the US and Canada.

Brands of biologic dressings include Acticoat, Biobrane, and TransCyte. Amniotic membranes and animal products have shown promise as well. None of these dressing alternatives are practical in the urgent care setting at this point but may be useful options in the near future.

Tetanus

Tetanus status should be addressed for any wounds deeper than superficial thickness. In patients who have not received a complete primary immunization, tetanus immune globulin—as well as the primary immunization—should be provided.

Antibiotics

Prophylactic antibiotics in any form are not recommended and have no proven benefit for the prevention of burn infections.

Disposition

All patients who meet the criteria for serious burns should be transferred to a burn center (see *When to Refer a Patient to a Regional Burn Center* on page 18) .

However, initial difficulties in differentiating superficial partial-thickness burns from deep partial-thickness burns and full-thickness burns, as well as concerns about the unpredictable evolution of injuries, should make consultation with a burn surgeon a precaution to consider. This is especially true if burns are on the face, hands, perineum, or feet, or if burns are on high-risk patients (eg, individuals who are elderly, immunosuppressed, or diabetic).

Contacting a burn specialist can help with identification of patients who warrant follow-up and ensure appropriate and timely care that can prevent long-term damage. In addition, specialist consultation is a legally prudent course of action; the basis of a malpractice suit, particularly given the unpredictable course of burn injuries, could well be failure to seek specialist advice. ■

Reference

1. Gehrig KA, Warshaw EM. Allergic contact dermatitis to topical antibiotics: Epidemiology, responsible allergens, and management. *J Am Acad Dermatol.* 2008;58(1):1–21.