

Burn Care and Management

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INTRODUCTION

Burns are commonly caused by thermal injury or chemicals, and they are very common injury. A severe burn can cause serious physical and psychological damage. Prevention and improvements in treatment have decreased morbidity and mortality rates associated with burns, but they are still a major cause of accidental death.

OBJECTIVES

When the student has finished this module, he/she will be able to:

1. Identify the two types of burns.
2. Identify the pathological process associated with acid burns.
3. Identify the pathological process associated with alkali burns.
4. Identify the three parameters used to assess a burn.
5. Identify the difference (s) between third-degree burns and other burns.
6. Identify three serious burns that require admission to a burn center.
7. Identify a serious complication associated with burns and inhalation.
8. Explain why fluid resuscitation is critical in the first 24 hours after a burn.
9. Identify the uses, advantages and disadvantages of a split-thickness graft.
10. Identify the uses, advantages, and disadvantages of a full-thickness graft.

PATHOPHYSIOLOGY OF BURNS

Thermal burns are caused by flame, contact with hot objects, steam, lightning and electricity, hot water, etc. They cause damage because of the difference in temperature between what causes the burn and the surface of the skin. The severity of the burn depends on the volume (with liquids and steam), the temperature, and the

duration of contact, and it takes very little time and a relatively low temperature to produce a serious burn. A child who is exposed to tap water that is $> 120^{\circ}\text{F}$ for only three seconds can suffer a severe burn. (Note: Home tap water temperature is often set at 140°F). Once the skin is exposed, the surface of the skin and the underlying tissue are damaged and becomes coagulated. Capillary permeability is increased and the viscosity of the plasma is increased, causing fluid loss, decreased circulation, and microthrombi.

Chemical burns are caused by **acids** (proton donors) and **alkalis** (proton acceptors). Acids cause burns by **coagulation necrosis**. The acid damages tissues by denaturing proteins, but this process produces a thick, tough scar which limits the skin penetration and further damage. Alkalis cause burns by **liquefaction necrosis**. Alkalis denature proteins but they also saponify (i.e., melt) lipids and destroy collagen. No scar is formed so the alkali continues to penetrate the skin and cause tissue damage. An acid with a pH of ≤ 3.0 may cause a serious burn, and an alkali with a pH of ≥ 11.0 may cause a serious burn. The seriousness of the burn depends on the concentration and the pH of the offending agent, and the contact time. Common causes of acid and alkali burns include:

- Acids, e.g., hydrofluoric, hydrochloric, muriatic, nitric, and sulfuric acid.
- Automobile battery acid.
- Cement.
- Drain cleaners.
- Hair relaxers/straighteners.
- High-concentration ammonia, bleach, or hydrogen peroxide.
- Metal cleaners.
- Oven cleaners.
- Some all-purpose household cleaners.
- Sodium azide powder from automobile airbags.
- Rust removers.

BURN ASSESSMENT

Assess each burn for **depth**, **extent**, and **severity**.

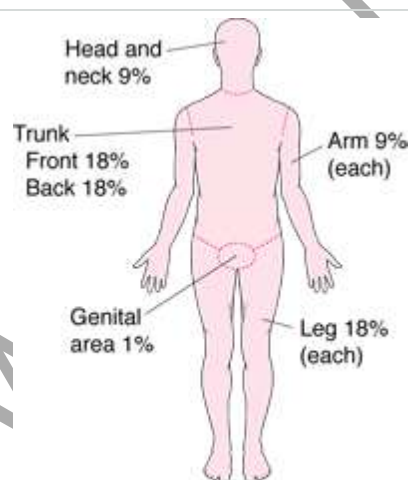
Depth

- First-degree/superficial: Tissue damage is limited to the epidermis. The skin blanches when touched and it is red, hot, edematous, and painful. There are no blisters. The burns almost always heal without scarring.

- Second-degree/partial thickness: The tissue damage extends to the dermis. Blisters form quickly or within 24 hours. The skin is red, hot, wet, but it does *not* blanch when touched. Scars are possible but enough tissue remains for the skin to regrow.
- Third-degree/full thickness: The tissue damage extends to the subcutaneous tissue and occasionally to bones, muscles, nerves, and tendons. The skin is white, sometimes charred, and there is no pain sensation at the area of the burn. Scarring can be extensive and tissue loss happens because the regenerative epithelial cells are destroyed.

Extent

The more body surface area (BSA) that is burned, the greater the morbidity and mortality. The classic method for evaluating the extent of a burn is the **Rule of Nines**.



Severity

Severe burns that require admission:

- Full-thickness burns > 5% BSA.
- Partial thickness burn > 10% BSA.
- Full-thickness or partial thickness burns of the face, feet, hands, genitals, or a major joint.
- Circumferential burns of the thorax or extremities.
- Burns and inhalation injury.

- > 15% BSA in adults.
- > 10% BSA in children.
- Significant burns from chemicals or electricity/lightning.
- Hydrofluoric acid burns of > 1% BSA of 50% solution or > 5% BSA of any concentration.

SERIOUS BURNS: PRE-HOSPITAL CARE

Assess and stabilize the airway, breathing, and circulation, stop the burning process (remove clothes, *briefly* cool the skin with saline or water), and begin fluid resuscitation.

Learning Break: Airway compromise is a leading cause of death from burns. If the exposure was to a flame, fire, etc., look for signs of inhalational injury: airway compromise, black sputum, facial burns, inability to speak, or singed facial/nasal hair.

SERIOUS BURNS: IMMEDIATE CARE IN-PATIENT CARE

Focus on **airway assessment, fluid resuscitation, pain control,** and **initial burn care.**

Airway edema and airway compromise may not be present when the patient first arrives, but it can develop very suddenly. A patient with significant signs/symptoms of inhalation injury should be intubated.

Capillary leakage and third spacing cause significant intravascular volume loss: some patients may only have 20%-30% of their normal intravascular volume. Third spacing self-corrects within 24 hours, so the first 24 hours after the burn is critical. Use the **Parkland formula** to calculate the patient's fluid needs.

2-4 mL of crystalloid x BSA x body weight in kg

Example: A patient with 20% BSA burn who weighs 65 kg should be given 2600-5200 mL of Ringers lactate IV in the first 24 hours. Fifty percent of the total should be given within the first eight hours: give the remainder over 16 hours.

With severe burns, an in-dwelling urinary catheter should be inserted to monitor fluid status. Some patients will need a pulmonary artery catheter for fluid management. Use dilaudid or morphine, IV, for pain.

Initial wound care involves maintaining the sterility of the patient's environment and applying topical antibiotics, e.g., polymixin b or silver sulfadiazine.

Laboratory studies should include a BUN, coagulation profile, complete blood count, serum creatinine, and creatinine phosphokinase.

SERIOUS BURNS: IN-PATIENT EXTENDED CARE

Treatment for patients with chemical and thermal burns is the same. After stabilization, focus on wound care and healing, fluid resuscitation, and prevention of and monitoring for complications. Patients who are obese or who have cardiovascular disease, diabetes, or hypertension are more likely to have complications or difficulty healing. Also, burns may cause a hypermetabolic state and immunosuppression and these prolong and complicate the healing process. Complications of burn healing include acute respiratory distress, syndrome, cosmetic deformity, contractures, infection, scarring, and sepsis.

WOUND CARE

First-Degree Burns and Second-Degree Burns

Cover first-degree burns with hydrocortisone cream, aloe vera cream or an antibiotic ointment. These are soothing, prevent infection, and protect the skin from mechanical damage. Cover with a sterile dressing. These burns heal within days and they rarely cause complications.

Second-degree burns may become infected and can take several weeks to heal. They should be covered with antibiotic ointment and a sterile dressing. The healing process should be closely monitored.

Learning Break: There is controversy about treatment of blisters. Intact blisters are a good barrier. However, the fluid is a medium for bacterial growth and if the blisters are debrided a topical antibiotic can reach the exposed skin, so some people advocate opening blisters. Open blisters should be debrided and covered with topical antibiotics.

Complex Burns

Deep, extensive, and severe burns will not heal well without intervention because there is not enough regenerative tissue – or there is no regenerative tissue – to re-grow new tissue. Also, serious, extensive burns in particular areas may cause complications. If a large area of the face is extensively burned, the skin will not grow back in a way that will produce an acceptable appearance. If there is a serious

burn over a major joint or a major area of function, e.g., the hand, an uninterrupted healing process can produce scars and contractures that might make normal functioning impossible.

Learning Break: Unless a deep, extensive, and serious burn is < 1 cm in an area where function or cosmetic appearance will not be affected, the burn should be managed by using **skin flaps, grafting, or other techniques.**

Burn Repair Techniques: Skin Flaps

Skin flaps are areas of skin, subcutaneous tissue, and blood supply that are moved/stretched from an area adjacent to the burn, or removed from a remote area and placed on the burn. Skin flaps can produce a better cosmetic result, provide bulk to fill in defects, and are more resilient than skin grafts, but they cannot be used to repair large burns.

Burn Repair Techniques: Grafting

Grafting is the removal of skin from the body and placing it over the burn area. Grafting promotes healing, prevents scars and contractures that would be deforming and/or limit function, and minimizes cosmetic damage. Grafting can be single stage or multiple stage, partial-thickness or full thickness.

Single-stage excision and grafting is only suitable for small burns. A single stage excision and grafting causes a lot of blood loss and the failure rates are high. **Multiple-stage excision and grafting** is preferred for most burns.

A **split thickness graft** includes the epidermis and part of the dermis. These grafts can cover large areas and the rejection rate is low. Split thickness grafts are relatively fragile, they contract a lot during healing, and the cosmetic appearance is often poor. The graft is often meshed to expand it (multiple punctures are made in the graft that allows it to be stretched) and after the graft is positioned, sutures are placed at the four corners and a running suture is placed around the border. Occasionally the graft will be secured with staples.

A **full-thickness graft** includes the epidermis and the complete dermis. Compared to a split-thickness graft, a full-thickness graft contracts less, the graft is more robust, and the functional and cosmetic outcome will be better. The disadvantages of a full-thickness graft are that it can only be used in small, well vascularized areas, healing at the graft site and the donor site can be problematic, and the failure rate is higher than that of split-thickness grafts. The graft is

secured with sutures at the four corners and a running suture around the border.

Learning Break: **Alloderm®** and **Integra®** are alternatives to grafting. Alloderm® is human allodermis, it is used for full-thickness burns, and it provides permanent wound coverage. Integra® is bovine collagen, shark chondroitin, and silicone, it is used for deep, serious burns, and it provides permanent wound coverage.

Preparing the Burn for Grafting

These techniques are used to prepare the burned area for the graft, help the burn heal, and prevent infection.

- **Escharotomy:** Eschar can be a source of infection. It can seriously impair circulation and eschar and third-spacing together can cause compartment syndrome. Escharotomy releases the pressure and constriction caused by eschar. It should be performed in the first 24 hours on burns that circumferentially surround a body part, e.g., abdomen, digit, extremity. It is done using conscious sedation or in the operating room under general anesthesia.
- **Debridement:** Debridement removes necrotic or contaminated tissue, foreign bodies, and debris from a wound. Debridement is usually performed on burns that will not need a graft.
- **Excision:** Excision removes necrotic tissue. It is similar to debridement, but more tissue and deeper layers of tissue are removed. It is performed on burns that will receive a graft or other reconstructive procedures.
- **Temporary skin substitutes:** Temporary skin substitutes can be used for initial treatment of serious burns if there is not enough donor skin and/or the wound closing will be large and extensive. Cadaver allograft, pigskin, Biobrane® (silicone, nylon and porcine collagen), and Transcyte® (Biobrane® combined with human fibroblasts) are in common use.

AFTER THE SURGERY

The initial dressing should be absorbent, non-adhesive, and semi-occlusive. The dressing prevents shear, the pressure prevents

hematoma formation, and keeps the graft in place. The initial dressing is left in place for 3-7days.

Grafting and other surgical procedures used to treat burns fail because of poor operative technique, a poorly prepared or weak recipient site, shifting of the graft, or hematomas.

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