



## Current Trends in Burn Care

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## Objectives

- Describes normal skin anatomy.
- Differentiates pathophysiology related to etiology of injury.
- Identify burn severity and depth.
- Discuss the components of the primary and secondary surveys.
- Discuss treatments and management of burns.



## Disclosure

- No disclosures to note.



## Introduction

- One million burns per year in United States
- 6% of burn center admissions die.
- Average size of a burn injury is 14% of total body surface area (TBSA).
- Most admissions to burn centers require transport to specialized care.
- Critical care transport professionals (CCTP) must be prepared to handle complications

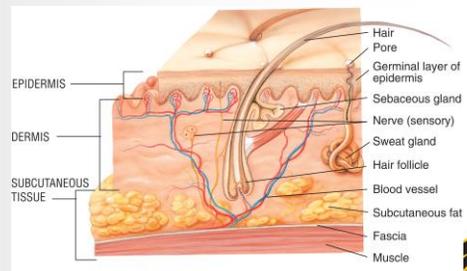


## Anatomy and Function of Skin (1 of 2)

- Skin is the largest organ of the human body
- Epidermis and dermis are the main layers
- Epidermis and dermis each contain several layers that have specific functions



## Anatomy and Function of Skin (2 of 2)





## Epidermis (1 of 2)

- Four layers (thin skin), except on palms, fingertips, and soles of feet
- Five layers (thick skin) on palms, fingertips, and soles of feet
  - Stratum basale (attached to dermis)
  - Stratum spinosum (prickly layer)
  - Stratum granulosum
  - Stratum lucidum (thick skin only)
  - Stratum corneum



## Epidermis (2 of 2)

- Stratum corneum
  - Prevents water loss from deeper structures
  - Constantly sloughs off dead cells
  - Takes approximately 3 weeks for a skin cell to become a keratinocyte and be shed
  - Is the first barrier to injury



## Dermis (1 of 3)

- Lies beneath the epidermis
- Cell types include fibroblasts, macrophages, white blood cells, and mast cells.
- Contains nerve fibers, blood vessels, lymphatic vessels, hair follicles, oil and sweat glands

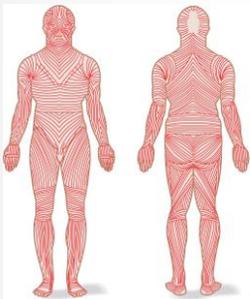


## Dermis (2 of 3)

- Papillary layer
  - Anchors epidermis
  - Heavily laden with blood vessels
- Reticular layer
  - 80% of the dermis
  - Dense connective tissue makes skin durable and anchors appendages.
  - Form lines of cleavage
  - Interlocking collagen fibers run in various planes
  - Hypodermis contains fat, connective tissue, sweat glands, muscle, and bone.



## Dermis (3 of 3)



## Process of Healing

- Fibroblasts produce proteins such as collagen and fibronectin.
- Macrophages increase in numbers after injury.
  - Release chemical messages that attract other cells and direct healing
- Endothelial cells produce capillaries and restore blood flow.



## Functions of Skin

- Protection (maintains fluid balance)
- Immunologic (keeps bacteria out)
- Thermoregulation (Large burns can cause hypothermia.)
- Fluid and electrolyte balance
- Metabolism
- Neurosensory
- Social



## Physiology of Burns

- Causes of burns
  - Flame/flash
  - Scald (water or grease)
  - Contact
  - Electrical
  - Chemical
  - Radiation
  - Thermal
  - Some diseases cause burn-like symptoms.



## Thermal Burns

- Thermal burns having temperatures of 113°F can cause cell damage and denaturing of cellular proteins.
- 120°F can cause a full-thickness burn in 5 minutes.
- 159°F can cause a full-thickness burn in 1 second in a healthy adult.



## Anatomy of a Burn

- Zone of coagulation: Direct contact
- Zone of stasis: Injured tissue and stagnant blood flow
- Zone of erythema: Area of minimal damage



## Systemic Inflammatory Response (1 of 2)

- Some inflammation is normal and necessary.
- Excessive inflammation can cause problems for other tissues and organs.
- Burns of greater than 25% TBSA result in systemic inflammatory response.



## Systemic Inflammatory Response (2 of 2)

- Problems associated
  - Proteins may leak into subcutaneous tissue
  - Pulmonary edema
  - Immune system suppression
  - Leaky endothelial cells in the intestine may allow bacteria to into the bloodstream.
  - Reduced cardiac output



## Burn Classification (1 of 2)

- Three factors to consider
  - Burn extent and depth
  - Burn size
  - Burn severity



## Burn Classification (2 of 2)

Depth	Color and Vascularity	Surface Appearance and Pain	Swelling, Healing, and Scarring
Superficial (first degree)	Erythematous, pink and red	No blisters Dry and tender	Slight edema Heals easily without scarring
Superficial to partial thickness (second degree)	Erythematous, bright pink/red, mottled Blanches with brisk capillary refill	Intact blisters, moist when removed Weeping wounds and extremely painful	Moderate edema Easily heals but with skin discoloration
Deep to partial thickness (second degree)	Red, waxy-white Blanches with slow capillary refill	Broken blisters, wet Sensitive to pressure, but not to light touch	Marked edema Heals slowly with hypertrophic scars
Full thickness (third degree)	White, black to red/tan No blanching, vessels thrombosed Poor distal circulation	Dry, leathery Anesthetic Hairs pull out easily	Skin grafting required Scarring likely after healing
Subdermal (fourth degree)	Charred	Obvious subcutaneous tissue involvement Anesthetic	Skin grafting and/or flap required Scarring after healing



## Burn Extent and Depth (1 of 5)

- Superficial or first-degree
  - Involve only epidermis
  - Result of ultraviolet light exposure (sunburn), mild scald injuries, or flash burns
  - Healing usually occurs without scarring in 7 days.



## Burn Extent and Depth (2 of 5)

- Partial-thickness or second-degree
  - Superficial partial-thickness burns
    - Epidermis and part of dermis are involved
    - Caused by hot liquids or contact with flame
    - Heal in 14–21 days



## Burn Extent and Depth (3 of 5)

- Partial-thickness or second-degree
  - Deep partial-thickness burns
    - Result of steam, oil, flames
    - Involve deeper layers of dermis
    - Difficult to distinguish from full-thickness burns
    - Skin is not blistered or charred.
    - Healing takes 21 days or more; may require grafts
    - Scarring is moderate.



## Burn Extent and Depth (4 of 5)

- Full-thickness or third-degree
  - Involves entire thickness of dermis down to subcutaneous fat
  - Epidermal structures, including nerve endings are destroyed.
  - Skin grafts are necessary.
  - Significant scarring



## Burn Extent and Depth (5 of 5)

- Subdermal or fourth-degree
  - Involves deep structures of muscle and bone, larger blood vessels, and nerves
  - Injuries are severe and life-threatening.
  - Requires surgical intervention

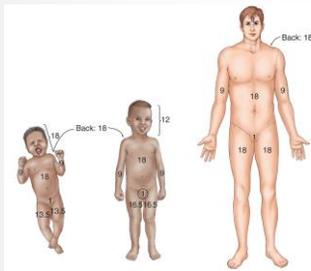


## Burn Size (1 of 3)

- Rule of nines
  - Used for adults
  - Based in the principle that body is divided into areas that represent 9% of TBSA.
- Lund and Browder chart
  - Preferred method
  - Difficult for emergency workers to memorize



## Burn Size (2 of 3)



## Burn Size (3 of 3)

Region	%
Head	
Back	
Ant. Thigh	
Post. Thigh	
Right arm	
Left arm	
Buttocks	
Genitals	
Right leg	
Left leg	
Total burn	

Age (years)	A (1/3 of head)	B (1/2 of arm thigh)	C (1/3 of one leg)
0	9 1/2	9 1/2	2 1/2
1	8 1/2	9 1/2	2 1/2
5	6 1/2	9 1/2	2 1/2
10	5 1/2	9 1/2	3
18	4 1/2	9 1/2	3 1/2
Adult	3 1/2	9 1/2	3

Adapted from Lund, C.C., and Browder, N.C., Surg. Gynecol. Obstet. 79 (1944): 352-358.



## Consensus Formula

- -2 to 4 mL's X weight in kg's X % TBSA burned
  - Adults, give 2 mL regimen
  - Pediatrics, give 3 mL regimen
  - Electrical Burns, give 4 mL regimen
- Give first half in first 8 hrs., then reconsider additional fluid administration based on urine output.



## Burn Severity (1 of 5)

- Major
  - Partial-thickness burns involving more than 25% TBSA (adults) or 20% TBSA (children under 10 and adults over 50)
  - Full-thickness burns over more than 10% TBSA
  - Burns involving face, eyes, ears, hands, feet, or perineum





## Initial Assessment

- Airway
- Breathing
- Circulation



## Airway (1 of 3)

- Inhalation of gases, particles, and other debris can damage respiratory epithelium.
- If inhalation injury is present, consider intubation.



## Airway (2 of 3)

- Signs of inhalation injury
  - Facial burns
  - Stridor or progressive hoarseness
  - Singeing of eyebrows and nasal vibrissae
  - Carbon deposits and inflammation of oropharynx
  - Carbonaceous (black) sputum



## Airway (3 of 3)

- Signs of inhalation injury (continued)
  - History of impaired mentation and/or confinement in a burning environment
  - Explosion with burns to head and torso
  - Circumferential neck burns
  - Carboxyhemoglobin level greater than 10% if the patient was in a confined space
  - Soot around nose or mouth



## Breathing (1 of 2)

- Non-cardiogenic pulmonary edema may result from inhalation injury or fluid overload.
- Start high-flow oxygen immediately.
- Use caution with people who have COPD.
- Watch for pneumothorax and hemothorax.



## Breathing (2 of 2)

- Patients with carbon monoxide poisoning may have hypoxia.
- Cyanide poisoning should be considered if patient has intense air hunger, metabolic acidosis, sudden cardiovascular collapse, or if the patient has been in a confined space fire.



## Circulation

- Burn patients may have impaired circulation.
- Hemoglobin levels 10g/dL preferred for flight
- Identification of circulatory problems is important for preventing amputation.
- Fluid resuscitation should be guided by formulas such as the Galveston and Parkland formulas.



## Compartment Syndrome

- Caused by fluid build-up because collagen does not stretch.
- Symptoms
  - Pain
  - Pallor
  - Paralysis
  - Paresthesias
  - Pulselessness



## Focused History and Physical Exam (1 of 2)

- Disability
  - Burn patients are usually awake and alert.
  - Unconscious or confused patients may have issues affecting their mental states.
  - CCTP should watch for changes in mental state.



## Focused History and Physical Exam (2 of 2)

- Exposure
  - Head-to-toe examination
  - If possible, remove dressings and inspect wounds.
  - Identify and correct inappropriate dressings.
  - Assess the patient for hypothermia.



## History (1 of 4)

- Thorough history of patient, incident, and treatment given required
- Patient information (SAMPLE)
  - Signs/symptoms
  - Allergies
  - Medications
  - Past medical or surgical history
  - Last meal or drink
  - Events leading to injury



## History (2 of 4)

- Mechanism of injury
  - Source of burn
  - Closed space and duration of exposure
  - Chemical exposure
  - Related trauma



## History (3 of 4)

- Prior interventions (scene)
  - Resuscitation required and fluid administered
  - Field decontamination



## History (4 of 4)

- Prior interventions (hospital)
  - Tetanus booster
  - Fluids given (amount and type)
  - Other treatments (antibiotics, sedation)
  - Procedures (central line placement, escharotomy)



## Management

- Stop the burn
- Airway and breathing
- Circulation
- Wound management and dressing
- Wound infection and treatment
- Pain control
- Other issues



## Stop the Burn (1 of 2)

- Remove patient from source of burn
- Cool the burn; do not continue beyond 20-30 minutes
- Leave blisters intact unless chemical burn
- Irrigation
- Remove clothing and jewelry.
- Keep patient warm and wrap in dry linens



## Stop the Burn (2 of 2)



## Airway and Breathing (1 of 2)

- Airway management difficult in burn patients.
- Assess patient for inhalation injury.
  - Perform intubation or other intervention as needed.
  - Consider sedation if patient is hemodynamically unstable.



## Airway and Breathing (2 of 2)

- Carbon monoxide poisoning, asphyxiation, and cyanide poisoning
  - Treat patient with 100% oxygen.
  - Monitor closely for hypoventilation.
  - Attempts to oxygenate patient to suprabaseline oxygenation levels can result in carbon dioxide retention, acidosis, arrhythmias, and respiratory arrest.



## Circulation (1 of 3)

- Early, aggressive, sustained fluid management is necessary.
- Burns can result in large intravascular fluid losses.
  - No protection against desiccation and evaporation
  - Circulating inflammatory mediators can cause fluid loss from capillaries into interstitial spaces



## Circulation (2 of 3)

- Fluid resuscitation
  - Parkland formula is most widely used
  - May be necessary to administer fluid more aggressively if patient is in shock
  - Galveston formula is more suitable for children
  - Carefully monitor urine appearance and output



## Circulation (3 of 3)



## Wound Management and Dressing (1 of 2)

- After cooling, irrigating, and decontaminating, wounds should be dressed in clean, dry dressings.
- Blisters should be left intact unless it is a chemical burn.
- Remove tars because they cause infection.
- Unless it is a chemical burn, have burn center perform debridement



## Wound Management and Dressing (2 of 2)





## Wound Infections and Treatment

- Infection does not occur for several hours.
  - Usually no need for CCTP to administer antibiotics
- Tetanus booster if patient has not had one in last five years
- Patients who have not had primary series need it as well as tetanus shot



## Pain Control

- Pain from burns is excruciating.
- Morphine is the best choice for patients who are not allergic.
- Pain should be assessed every 10 minutes until patient is comfortable.
- Monitor patient for altered signs of consciousness.



## Other Issues (1 of 3)

- Hypothermia
  - Remove wet clothing, dressings, and linens.
  - Use dry sheets and blankets.
  - Use warm IV fluids.



## Other Issues (2 of 3)

- Gastric decompression
  - Patients with greater than 20% TBSA are prone to ileus.
  - Use nasogastric tubes.
  - Decompression of stomach will reduce discomfort, bloating, and vomiting.



## Other Issues (3 of 3)

<b>Respiratory Status</b> • Assess for hypoxia • Monitor for dyspnea • Document vital signs
<b>Emergency Management</b> • Airway management • Oxygenation • Fluid resuscitation • Pain management • Wound care • Infection control • Psychological support • Patient education • Documentation
<b>Other Patient History</b> • Allergies • Current medications • Past medical history • Social history • Family history
<b>Current Risk Factors</b> • Burns • Infection • Pain • Fluid overload • Hypothermia • Hypotension • Hypoxia • Electrolyte imbalance • Organ dysfunction



## Special Situations (1 of 10)

- Renal failure and rhabdomyolysis
  - Rhabdomyolysis: If urine output does not improve with fluid resuscitation, increase fluids, add sodium bicarbonate, and consider adding a diuretic such as mannitol.
  - Patients with preexisting cardiac and renal dysfunction may develop pulmonary edema and congestive heart failure.



## Special Situations (2 of 10)

- Ocular burns
  - All burn patients should have a thorough eye exam.
  - Copious irrigation
  - Irrigation should occur for 20 minutes.
  - Morgan lenses
  - Lactated Ringer's solution



## Special Situations (3 of 10)

- Facial burns
  - Ocular and airway injuries are major concerns.
  - Face develops edema quickly
  - Head of stretcher should be elevated 30°



## Special Situations (4 of 10)

- Ear burns
  - Ear canal and eardrum should be examined before edema develops
- Circumferential burns and compartment syndrome
  - Burns that encircle the chest, an extremity, or the penis
  - These injuries may require an esharotomy.



## Special Situations (5 of 10)

- Hand and foot burns
  - Maintaining circulation is highest priority
  - Simple interventions such as elevation and avoiding constrictive dressings
  - Do not apply ice, as it may cause frostbite.
  - Do not apply creams or ointments.



## Special Situations (6 of 10)

- Genitalia burns
  - Should not distract health care providers from life-threatening injuries
  - Foley catheter
  - Penis should be examined for circumferential burns and impaired circulation



## Special Situations (7 of 10)

- Pediatric burns and child abuse
  - Children have more surface area per kilogram.
  - Children have less glycogen stores than adults.
  - 25% of all childhood burns are caused by child abuse.
  - All suspected child abuse must be reported.



## Special Situations (8 of 10)

- Electrical burns
  - Damage to deep tissues is not always visible.
  - Cardiac arrest and renal failure are possible.
  - Lightning burns may leave extensive superficial burns in a fern or reticular pattern.



## Special Situations (9 of 10)

- Chemical burns
  - Caused by common household, industrial, and farm products
  - Patients should be completely disrobed and irrigated with copious amounts of water.
  - Chemicals may be absorbed into the skin and continue to burn.
  - Do not attempt to neutralize the burn with another chemical.



## Special Situations (10 of 10)

- Toxic Epidermal Necrolysis Syndrome
  - Reaction to medications, environmental allergens, and other toxins
- Stevens-Johnson Syndrome
  - Believed to be an autoimmune disorder



## Skill Drill 12-1: Performing an Emergency Escharotomy



Prepare your equipment. Administer sedation and pain medications. Maintain an aseptic technique. Determine a well-defined incision pattern.



Incise the derma of the burned tissue.



Prepare to manage bleeding. Apply a sterile dressing.