

Thermal Burns

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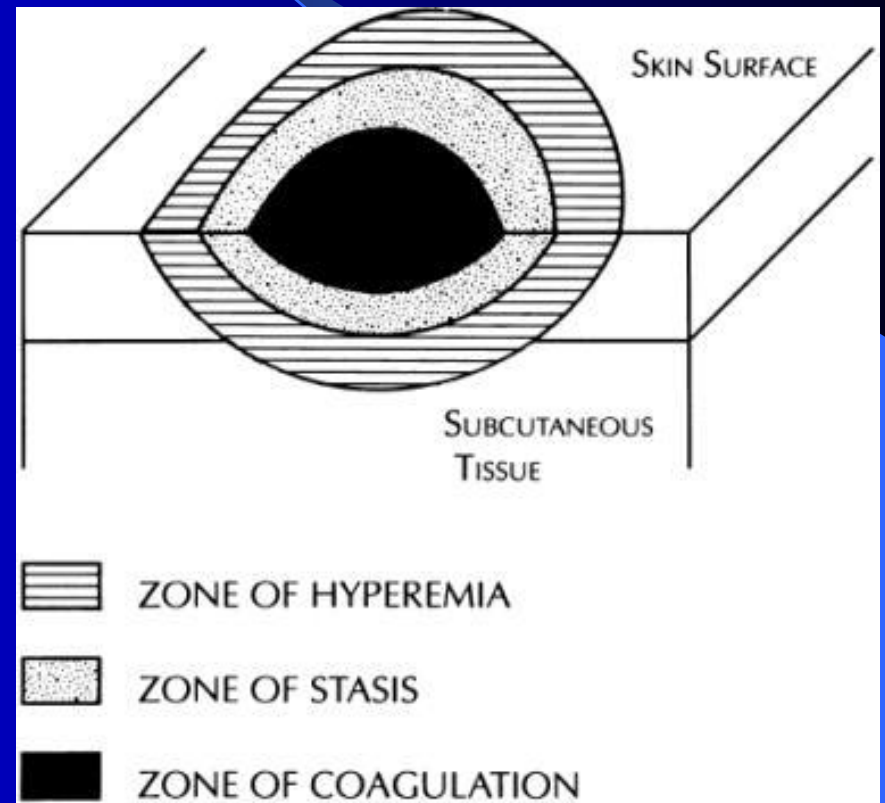
You will know...

- Types, severity, and extent of thermal burns
- Pre-hospital management goals
- Smoke inhalation injury and treatment
- Evidence behind the Parkland formula and fluid resuscitation goals
- Treatment of major and minor burn wounds

Burn Zones

Burns consist of three geographic zones

- **Zone of coagulation:** center of burn; greatest heat transfer
- **Zone of stasis:** pronounced inflammation and vascular injury; cell survival tenuous
- **Zone of hyperemia:** tissue injury minimal; expected recovery



Burn Classification

- Assessment should include an assessment of depth and total body surface area (TBSA) burned
- **First degree burn:**
- involves epidermal layer of the skin but not dermis;
- characterized by pain, erythema and lack blisters; generally heal in about 7 days without scarring;
- not considered in TBSA
- Sunburn is usually given as a common example of a first-degree burn,

First degree burn:



Burn Classification

- **Second degree burn:**
- divided into superficial and deep partial thickness
- *Superficial partial thickness*
- involves the papillary dermis;
- painful; blisters are present or may develop;
- heal over 2-3 weeks with no scar
- *Deep partial thickness*
- damages both papillary and reticular dermis plus deeper sweat glands and follicles;
- may or may not be painful;
- 3 or more weeks to heal and often will scar

Second degree burn:



Burn Classification

- **Third degree or full thickness:**
- involve all layers and may destroy subcutaneous tissue;
- white or charred;
- insensate;
- require skin grafting
- **Fourth degree:**
- involve structures below the subcutaneous fat including muscle and bone

Third degree or full thickness:



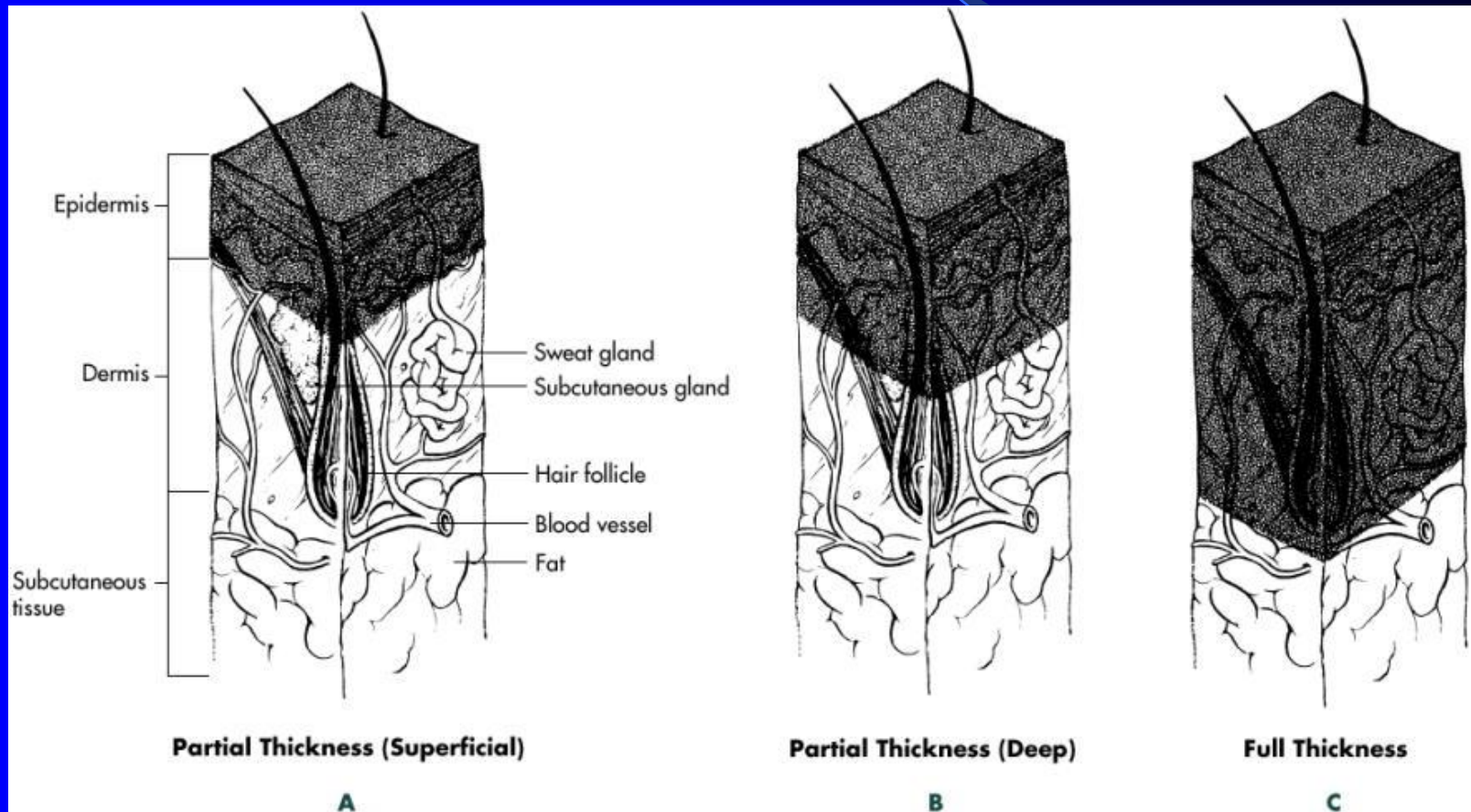
Fourth degree:



TABLE 210-2 Burn Depth Features Classified by Degree of Burn

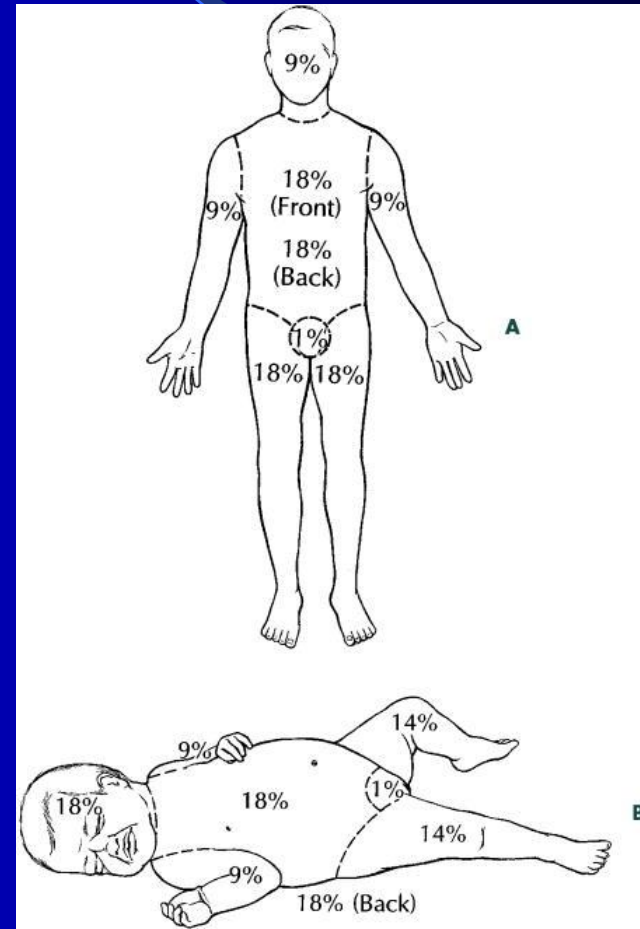
Burn Depth	Histology/Anatomy	Example	Healing
First degree	Epidermis No blisters, painful	Sunburn	7 d
Superficial second degree or superficial partial thickness	Epidermis and superficial dermis Blisters, very painful	Hot water scald	14–21 d, no scar
Deep second degree or deep partial thickness	Epidermis and deep dermis, sweat glands, and hair follicles Blisters, very painful	Hot liquid, steam, grease, flame	3–8 wk, permanent scar
Third degree	Entire epidermis and dermis charred, pale, leathery; no pain	Flame	Months, severe scarring, skin grafts necessary
Fourth degree	Entire epidermis and dermis, as well as bone, fat, and/or muscle	Flame	Months, multiple surgeries usually required

Degree of Burn Wound Depth



Wound Assessment: Rule of Nines

Head	9 %
Arm	9 %
Front	18 %
Back	18 %
Leg	18 %
Perineum	1 %
*palm of hand	1 %



Pediatric Burn Assessment

- Rule of 9's not applicable b/c head relatively larger than legs
- Lund-Browder or Berkow chart divides chart into smaller units and makes age appropriate corrections

DALLAS COUNTY HOSPITAL DISTRICT
Dallas, Texas

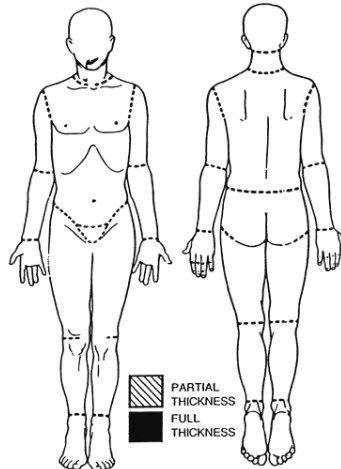
BURN RECORD

To be completed upon admission:

Date: _____

Height: _____ Weight: _____

2° _____ + 3° _____ = _____ %



Percent Surface Area Burned (Berkow Formula)

AREA	1 YR.	1-4 YRS.	5-9 YRS.	10-14 YRS.	15 YRS.	ADULT	2°	3°
Head	19	17	13	11	9	7		
Neck	2	2	2	2	2	2		
Ant. Trunk	13	13	13	13	13	13		
Post. Trunk	13	13	13	13	13	13		
R. Buttock	2½	2½	2½	2½	2½	2½		
L. Buttock	2½	2½	2½	2½	2½	2½		
Genitalia	1	1	1	1	1	1		
R.U. Arm	4	4	4	4	4	4		
L.U. Arm	4	4	4	4	4	4		
R.L. Arm	3	3	3	3	3	3		
L.L. Arm	3	3	3	3	3	3		
R. Hand	2½	2½	2½	2½	2½	2½		
L. Hand	2½	2½	2½	2½	2½	2½		
R. Thigh	5½	6½	8	8½	9	9½		
L. Thigh	5½	6½	8	8½	9	9½		
R. Leg	5	5	5½	6	6½	7		
L. Leg	5	5	5½	6	6½	7		
R. Foot	3½	3½	3½	3½	3½	3½		
L. Foot	3½	3½	3½	3½	3½	3½		
TOTAL								

Burn Severity Classification

Burn Classification	Burn Characteristics	Disposition
Major burn	Partial thickness >25% BSA, age 10–50 y Partial thickness >20% BSA, age <10 y or >50 y Full thickness >10% BSA in anyone Burns involving hands, face, feet, or perineum Burns crossing major joints Circumferential burns of an extremity Burns complicated by inhalation injury Electrical burns Burns complicated by fracture or other trauma Burns in high-risk patients	Burn center treatment
Moderate burn	Partial thickness 15%–25% BSA, age 10–50 y Partial thickness 10%–20% BSA, age <10 y or >50 y Full thickness burns ≤10% BSA in anyone No major burn characteristics present	Hospitalization
Minor burn	Partial thickness <15% BSA, age 10–50 y Partial thickness <10% BSA, age <10 y or >50 y Full thickness <2% in anyone No major burn characteristics present	Outpatient treatment

Inhalation Injury

- Smoke inhalation accounts for more than 50% of fire-related deaths
- Most injuries occur from inhalation of smoke but rarely superheated air produces direct thermal injury (especially steam)
- Smoke inhalation is a combination of direct pulmonary injury and systemic and metabolic toxicity



Carbon Monoxide Poisoning

- CO much higher affinity for Hgb than O₂
- Pulse oximetry overestimates hemoglobin O₂ saturation
- ABG measurement for carboxyhemoglobin value
- Patients exposed to CO should receive 100% O₂ by nonrebreather (CO $\frac{1}{2}$ life decreased from 240 – 60 minutes)
- HBO therapy if CO level >25 %, myocardial ischemia, dysrhythmia; CO level > 15 % in pregnant women or young child

Cyanide Poisoning

- Cyanide is released when natural and synthetic polymers such as wool, vinyl and plastics are burned
- Cyanide causes tissue hypoxia by uncoupling oxidative phosphorylation in mitochondria
- Consider Rx in patients with unexplained severe metabolic acidosis associated with elevated central venous O₂ (therefore patients are clinically not cyanotic), normal arterial O₂ content and low CO
Hgb

Treatment of Cyanide Poisoning

1. 100% O₂
2. Amly nitrite, crack vial and inhale (not necessary if IV in place)
3. Sodium nitrite: 10 ml IV*
4. Sodium thiosulfate: 50 ml IV*
5. Repeat at ½ doses if symptoms persist

*Above available as kit

Clinical Assessment

- History of explosion or trapped in building
- Physical examination demonstrates facial burns, singed eyebrows or nasal hair, pharyngeal burn, carbonaceous sputum or impaired mentation
- Changes in voice, stridor or wheeze alarming

Management

- Natural history of upper airway burn is edema that narrows the airway over 12 –24 h
- Intubation recommended in patients with:
 - (1) full-thickness burns of the face or perioral region,
 - (2) circumferential neck burns,
 - (3) acute respiratory distress,
 - (4) progressive hoarseness or air hunger,
 - (5) respiratory depression or altered mental status,
 - (6) supraglottic edema and inflammation on bronchoscopy.
 - (7) stridor, wheeze, voice changes

TREATMENT

- (1) prehospital care,
- (2) ED resuscitation and stabilization,
- (3) admission or transfer to a specialized burn center

PREHOSPITAL CARE

- (1) stop the burning process,
- (2) establish the airway,
- (3) initiate fluid resuscitation,
- (4) relieve pain,
- (5) protect the burn wound,
- (6) transport the patient to an appropriate facility

Pre-hospital Management

- Typical measures including primary and secondary survey, initial stabilization (i.e.. c-spine, splinting other injuries)
- High flow O₂ or intubation if inhalation injury suspected
- Removal of burned clothing and jewelry
- Small burns should be covered with wet dressing as decrease pain and thermal injury if initiated in 1st 40 min

Pre-hospital Management

- Large burns ($> 20\%$ TBSA) should be covered with clean dry dressings b/c risk of hypothermia
- IV should be initiated if it doesn't delay transport
 - Adult and adolescent 500cc/hr RL
 - Child (5 –15) 250 cc/hr
 - < 5 yrs do not attempt IV as may prevent transport delay (as per burn life support protocol)



ED MANAGEMENT

TABLE 210-5 ED Care of Patients with Major Burns

Airway	Breathing
Reevaluation of airway	Continuous pulse oximetry with supplemental O ₂
Early intubation for any sign of airway burn, swelling, or inhalation injury	Determination of carboxyhemoglobin level
	Bronchoscopy if inhalation injury is a concern
	Mechanical ventilation as needed

Circulation	Adjuncts
Establishment of two large-bore peripheral IV lines in unburned skin	Placement of Foley catheter
IV administration of lactated Ringer's solution using Parkland or other burn resuscitation formula	Insertion of nasogastric tube
Cardiac monitoring	Administration of tetanus booster
	Assessment for other trauma using ATLS guidelines
	Pain control

Parkland Formula

TABLE 210-6 Parkland Formula for Fluid Resuscitation

Adults

LR $4 \text{ mL} \times \text{weight (kg)} \times \% \text{ BSA burned}^*$ over initial 24 h

Half over the first 8 h from the time of burn

Other half over the subsequent 16 h

Example: 70-kg adult with 40% second- and third-degree burns:

$4 \text{ mL} \times 70 \text{ kg} \times 40 = 11,200 \text{ mL}$ over 24 h

Children

LR $3 \text{ mL} \times \text{weight (kg)} \times \% \text{ BSA burned}^*$ over initial 24 h plus maintenance

Half over the first 8 h from the time of burn

Other half over the subsequent 16 h

Abbreviations: BSA = body surface area; LR = lactated Ringer's solution.

*Second- and third-degree burns only.

Pain Control

- Pain requirements inversely proportional to depth of burn
- Full thickness burns are painless because sensory nerves damaged
- Partial thickness burns have intact nerves and are extremely painful
- Morphine advocated for pain management
 - Low protein binding
 - Metabolized by liver and excreted in urine
- Rapid elimination may result in doses $> 50\text{mg/h}$

GI/GU Complications

- Foley catheter should be placed to monitor fluid resuscitation
- Perineal burns should also have foley placed to decrease urinary soilage
- Gastric ileus is common involving burns more than 20 %; NG tube should be placed
- Gastric ulcers may occur in patients with severe burns; GI prophylaxis necessary

Burn Wound Care: Major Burns

- Full thickness circumferential burns can result in vascular compromise necessitating *escharotomy*
 - Performed on medial and lateral aspect of extremity and extend length of constricting eschar
 - Can use scalpel or electro-cautery
- Following escharotomy tissue edema can result in compartment syndrome necessitating fasciotomy



Major Wound Dressing

- Gentle cleansing with saline or commercial product (Shur-Clens)
- Debridement of devitalized tissue and blisters (except those on palms and soles)
- Application of topical antimicrobials
- Transfer to burn center

Burn Wound Care: Minor Burns

- Proper patient selection and appropriate follow-up:
 - The injury should be isolated and should not involve the hands, face, feet, or perineum.
 - The burn should not cross major joints or be circumferential.
 - When a minor burn is treated, the patient's social and medical situation should be considered.

Burn Wound Care: Minor Burns

TABLE 210-7 ED Care of Minor Burns

Provide appropriate analgesics before burn care and for outpatient use

Cleanse burn with mild soap and water or dilute antiseptic solution

Debride wound as needed

Apply topical antimicrobial:

1% silver sulfadiazine cream (not on the face or in patients with a sulfa allergy)

Bacitracin ointment

Triple-antibiotic ointment (neomycin, polymyxin B, bacitracin zinc)

Consider use of synthetic occlusive dressings

Provide detailed burn care instructions with follow-up in 24–48 h

Minor Burn Care

- **General Care.** Clean with soap and water. Leave hair intact. Debride devitalized tissue and ruptured blisters. Tetanus booster.
- **Blisters.** Management controversial. Poor evidence either way. Generally leave intact. If large or tense decompress with needle aspiration.

Minor Burn Care

- **Dressings.**
- Some minor burns can be left open (i.e. face neck).
- Wash twice daily with soap.
- Care in sun b/c of hyperpigmentation.
- Most minor burns are dressed. Dressing should be changed daily or every other day. Burn should be cleaned with soap and water with dressing changes.

Minor Burn Care

- **Topical antibiotics.** Continued debate. Decrease infection in serious burns with 50 % mortality reduction. Agents include sulfazidine (flamazine), mafenide acetate, silver nitrate. No evidence that these medications offer any benefit in 1st degree or partial thickness injury. Most experts agree that topical antimicrobials useful in large, deep partial or full thickness burns. Aloe vera may also be beneficial

Minor Burn Care

- **Synthetic dressings.**
- Include tegaderm, duoderm, etc.
- Useful for partial thickness burns promoting healing, decreasing pain and requiring less frequent dressing changes.
- Not indicated for full thickness burns and should not be applied to infected burns.
- Blisters and devitalized tissue need to be debrided.
- Can only be applied on fresh burns 1-2 cm over burn margin and needs to be changed daily