# BURN AND THERMAL INJURIES

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# OBJECTIVES

**Thermal Burns**

1. pathophysiology
2. Zones of burns.
3. Classification for burn injuries.
4. Rule of 9's.
5. Upper airway and lower airway burns.
6. Intubation in the burn patient.
7. Formulas of fluid resuscitation.
8. Escharotomy.
9. Burn unit criteria.
10. Basic burn dressing management.
11. Burn prevention strategies.

# PATHOPHYSIOLOGY

- Skin function as a semipermeable barrier to evaporate water
- Other function of the skin include protection from adversities of the environment, control of body temperature , sensation  and excretion
- Partial thickness thermal injuries can result in disruption of barrier function and contribute to free water deficits. The effect may be significant in moderate to severe burns

# PATHOPHYSIOLOGY

- Thermal injuries result in spectrum of local and systemic homeostatic derangement that contribute to burn shock
- Fluid and electrolytes abnormalities are largely due to alteration of cellular membrane potentials with intracellular influx of water and sodium and extracellular migration of potassium secondary to dysfunction of sodium pump

# MCQ 1-

- In burns Fluid and electrolytes abnormalities are largely due to alteration of cellular membrane function with
- A. influx of sodium *
- B. efflux of water
- C. influx of potassium
- D. perfect sodium pump

# PATHOPHYSIOLOGY

- In burns greater than 60% of body surface area, depression of cardiac output is frequently observed with lack of response to aggressive volume resuscitation due to increased systemic vascular resistance and circulating myocardial depressants and significant metabolic acidosis
- Thermal injuries is progressive injury . Local effects include liberation of vasoactive substances, disruption of cellular function and edema formation
- Cell damage occur at a temperature more than 45’c owing to denaturation of cellular protein

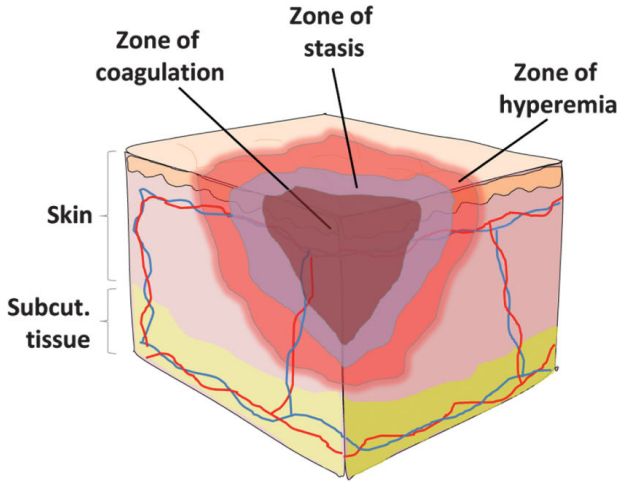
# PATHOPHYSIOLOGY

- Burn wound is described as having three zones
- Zone of coagulation where tissue is irreversibly destroyed with thrombosis of blood vessels
- Zone of stasis where there is stagnation of the microcirculation
- Zone of hyperemia where there is increased blood flow
- Zone of stasis can become progressively more hypoxemic and ischemic if resuscitation is not adequate
- In the zone of hyperemia there is minimal damage and spontaneous recovery is likely

# MCQ 2-

- Regarding zones of skin burn which one is correct
- A. Zone of coagulation where tissue is irreversibly destroyed with thrombosis of blood vessels *
- B. Zone of hyperemia where there is stagnation of the microcirculation
- C. Zone of stasis there is minimal damage and spontaneous recovery is likely
- D. Zone of hyperemia there is maximum damage and spontaneous recovery is unlikely

# ZONES OF BURNS



# HIGHLIGHTS

- Five percent to 35% of patients hospitalized with burns will have inhalational injury
- 44% of thermal burns due to flame exposure, 33% from scalding, 9% direct conductive burns from hot objects, 4% electrical burns, and 3% chemical burns.
- Most commonly affected are upper extremities (41%), then lower extremities (26%), and head and neck (17%)
- Overall survival rate 95%.

# MCQ 3-

Most commonly affected part of the body is

A. Head and neck

B. trunk

C. upper extremity

D. lower extremety

# HIGHLIGHTS

- 70% of burn victims are male, risk is highest 18-35 years.
- Risk of death from burn increases with:
  - Larger burn size.
  - Older age.
  - Female.
  - Presence of inhalation injury.

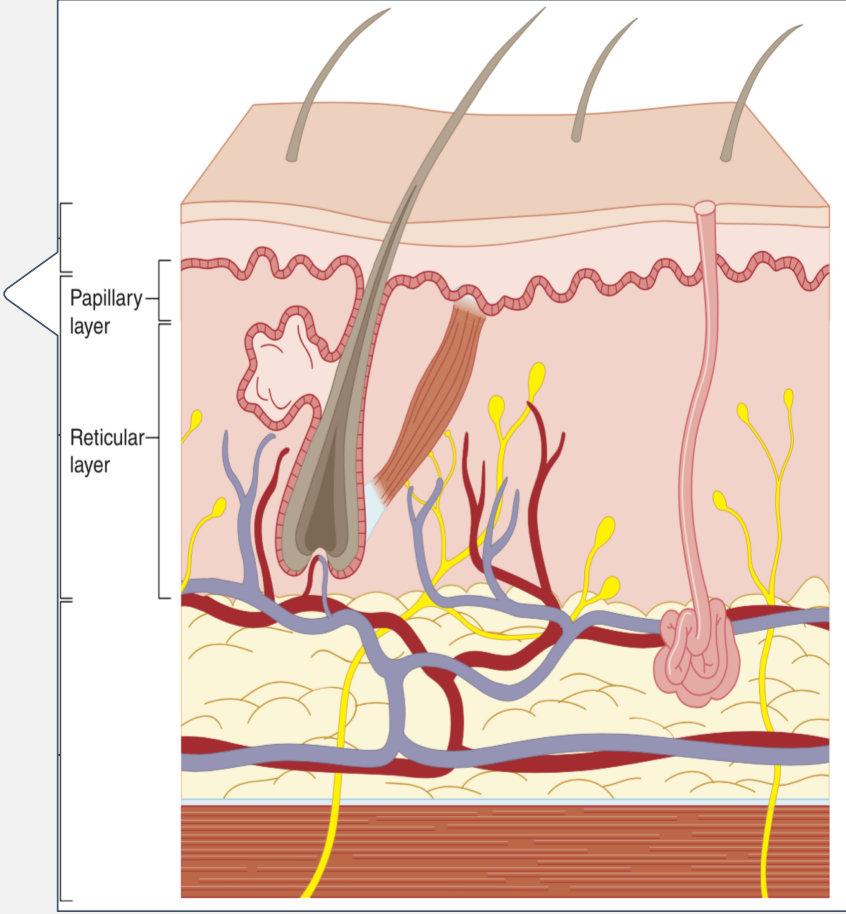
# MCQ 4-

Risk of death from burn increases with:

- A. smaller burn size.
- B. middle age.
- C. male.
- D. Presence of inhalation injury.

# SKIN AND ITS FUNCTION

- Skin functions as a semipermeable barrier to evaporative water loss, protects against environmental assault and infections, and aids in the control of body temperature, sensation, and excretion.



# PATHOPHYSIOLOGY

**TABLE 217-1** Physiologic Effects of Thermal Injury

- Disruption of sodium pump
- Intracellular influx of sodium and water
- Extracellular efflux of potassium
- Depression of myocardial contractility (>60% of body surface area burned)
- Increased systemic vascular resistance
- Metabolic acidosis
- Increase in hematocrit and increased blood viscosity
- Secondary anemia from erythrocyte extravasation and destruction
- Local tissue injury
- Release of histamines, kinins, serotonins, arachidonic acids, and free oxygen radicals

- First 3 will cause the acid base and fluid deficits
- Depression of myocardium because of overwhelming circulating inflammatory mediators.
- Increase in metabolic rate up to 3 times, so early initiation of feeding is helpful.

# PREHOSPITAL EVALUATION

- Stop the burning process.
- Secure airway if indicated.
- Initiate fluid resuscitation.
- Relieve pain.
- Protect wound.
- Transfer.
- Primary and secondary survey.
- The patient must be extricated from the burning environment
- burning clothing must be immediately removed.
- Rings, Belts, watches, and jewelry should be removed because they retain heat.

**TABLE 56.1**

## Clinical Estimation of Burn Depth

| DEPTH | APPEARANCE | BLANCHES WITH PRESSURE | SENSITIVITY TO PINPRICK | PLIABILITY | TIME TO HEALING | NEED FOR EXCISION AND GRAFTING |
|---|---|---|---|---|---|---|
| Superficial (first degree) | Red, no blisters | + | ++ | Soft | 1 week | – |
| Superficial partial thickness (second degree) | Red, blisters | + | ++ | Soft | 1 to 2 weeks | – |
| Deep partial thickness (second degree | Red or white, no blisters | ± | + | Slightly tense | 2 to 3 weeks | + |
| Full thickness (third degree) | Leather like, charred | – | – | Stiff, leather like | >3 weeks | + |

# CLASSIFICATION OF BURN INJURIES

# MCQ 5

- In secodery degree burn there is
- A. only there is hyperemia
- B. there is blisters
- C. heals without scaring
- D. involve skin and subcutaneous  tissue and muscles

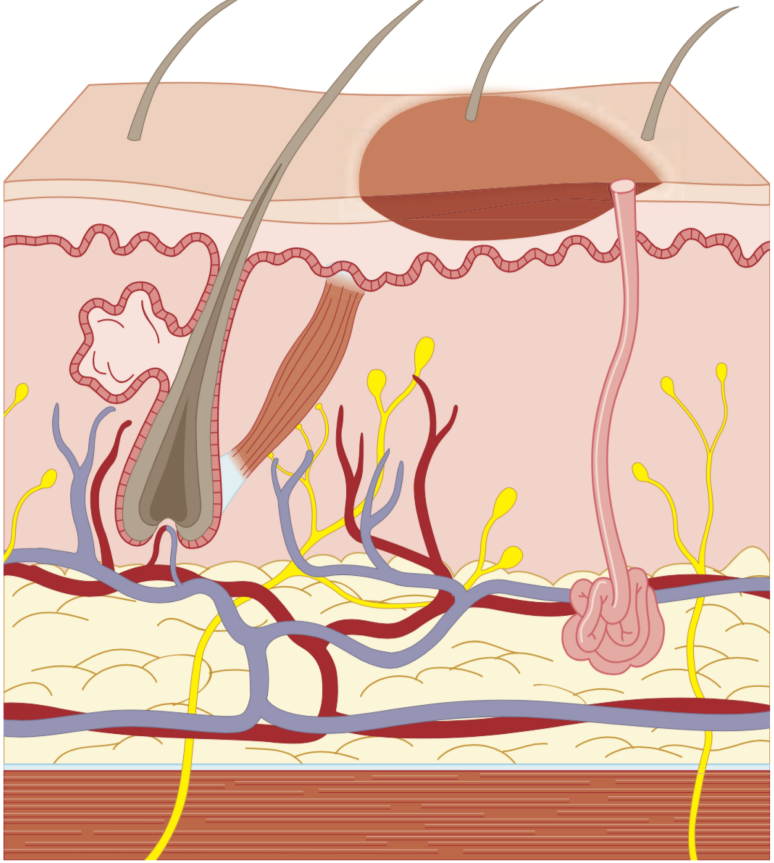


**FIGURE 217-4.** Superficial burn.

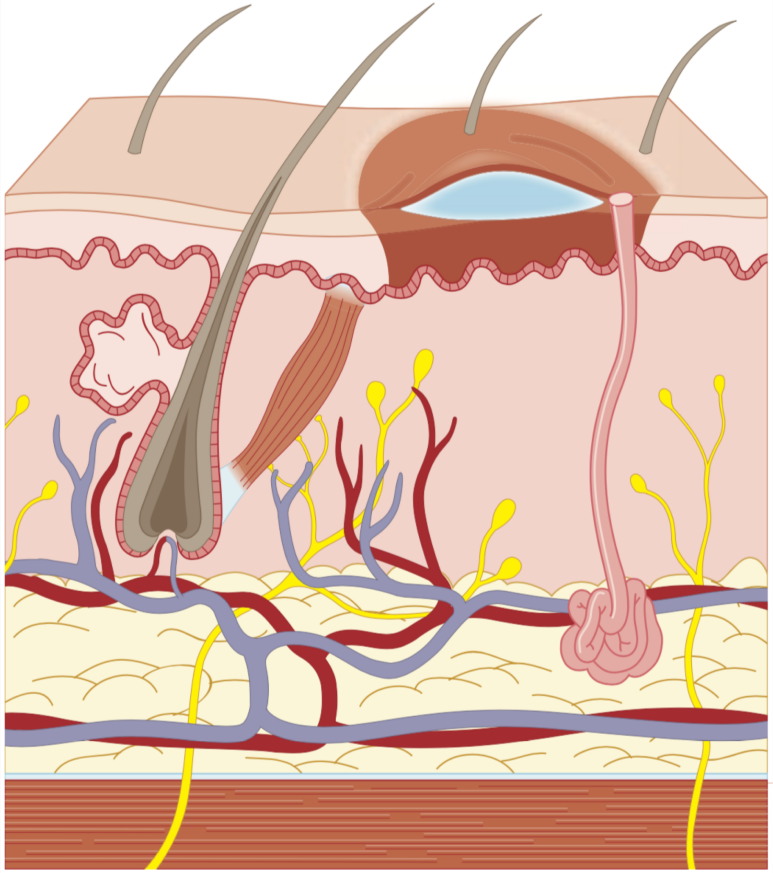


**FIGURE 217-5.** Superficial partial-thickness burn.

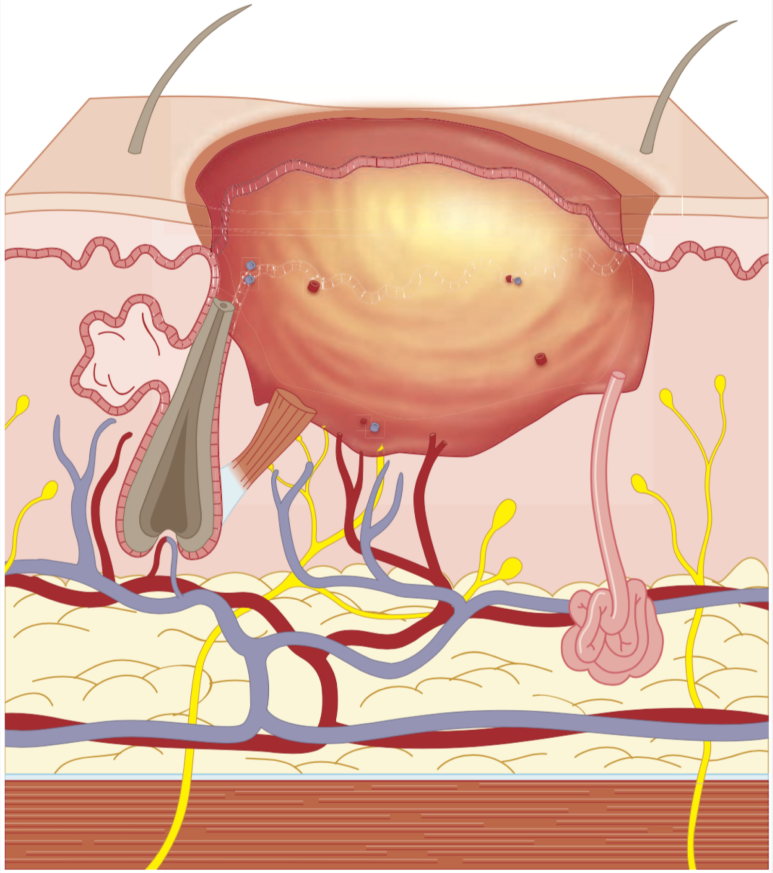


**FIGURE 217-6.** Deep partial-thickness burn.

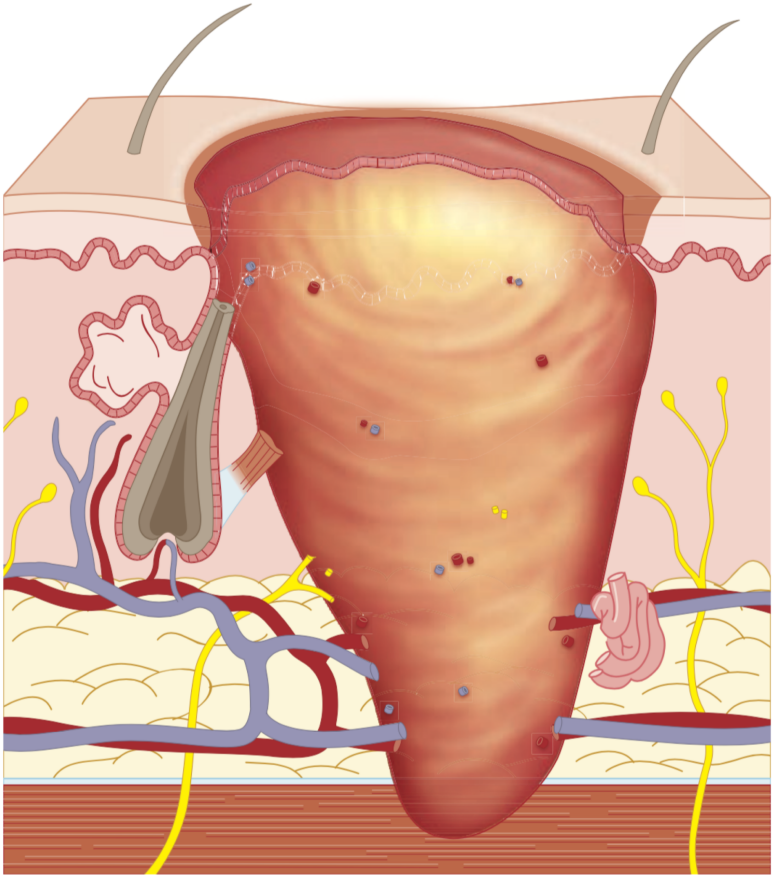
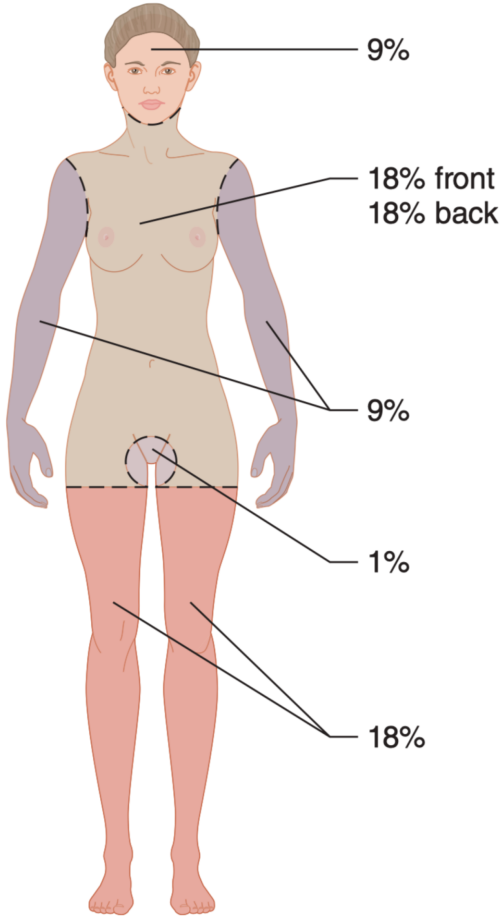
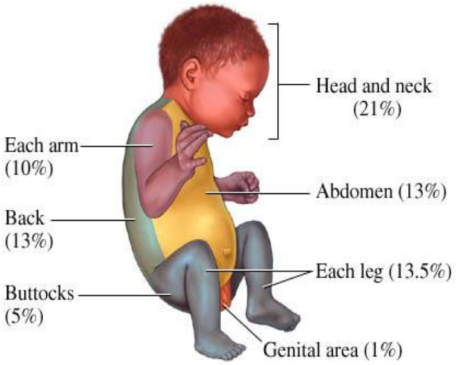


**FIGURE 217-7.** Full-thickness burn.

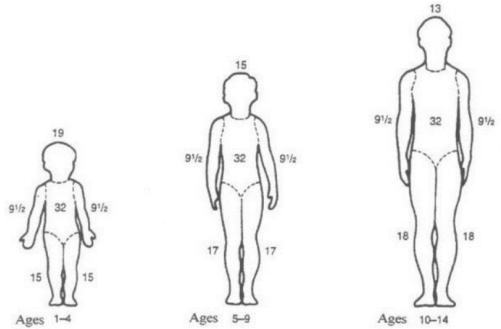
# RULE OF 9'S



**Rule of Nines for Infants** (Age < 1 year)

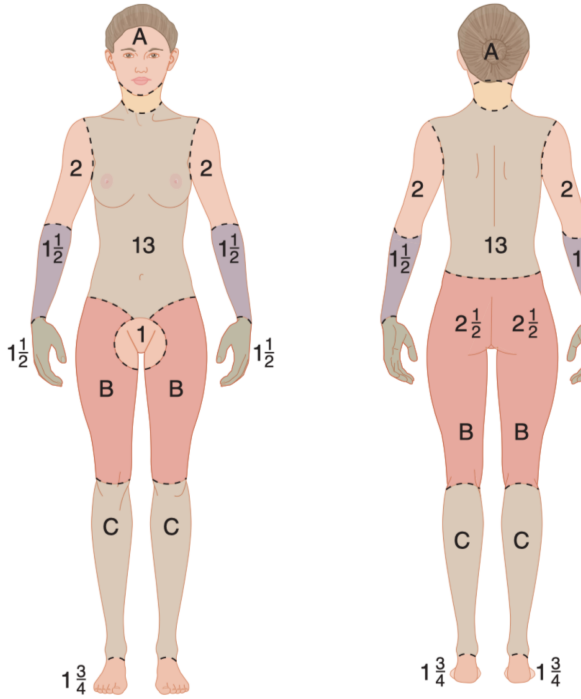



**Rule of Nines for Children** (1-14 years)




# RULE OF 9'S IN PEDIATRICS

# LUND-BROWDER DIAGRAM




Relative percentages of areas affected by growth (age in years)

| | 0 | 1 | 5 | 10 | 15 | Adult |
|---|---|---|---|---|---|---|
| A: half of head | $9\frac{1}{2}$ | $8\frac{1}{2}$ | $6\frac{1}{2}$ | $5\frac{1}{2}$ | $4\frac{1}{2}$ | $3\frac{1}{2}$ |
| B: half of thigh | $2\frac{3}{4}$ | $3\frac{1}{4}$ | 4 | $4\frac{1}{4}$ | $4\frac{1}{2}$ | $4\frac{3}{4}$ |
| C: half of leg | $2\frac{1}{2}$ | $2\frac{1}{2}$ | $2\frac{3}{4}$ | 3 | $3\frac{1}{4}$ | $3\frac{1}{2}$ |

# RULE OF HAND

# UPPER AND LOWER AIRWAY BURNS

**Upper airway (supra-glottic):**

- Soot in and around nose/mouth
- Charring
- Mucosal inflammation or necrosis
- Edema

**Lower airway (subglottic):**

- Wheezing
- Crepitations
- Hypoxemia
- Abnormalities on chest x-ray
- V/Q mismatch, decreased lung compliance, microatelectasis, and eventually ARDS

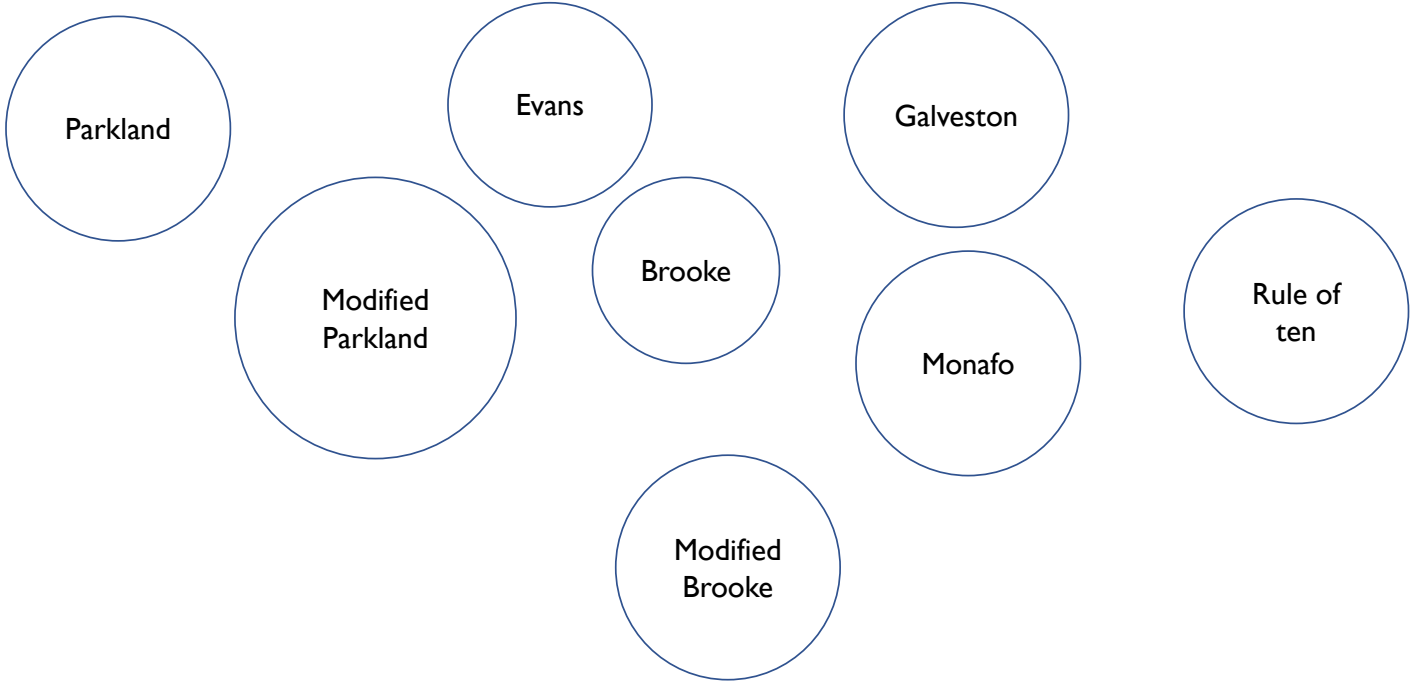
# NOTE:::

- Be aware, these signs are only moderately sensitive or specific.
- The true dx requires: direct visualization with fibroscopy before / after intubation….showing:
  - Soot, charring, mucosal inflammation, edema, necrosis
  - thermal injuries below the level of the vocal cords are less likely, but can occur in cases of steam inhalation.
  - Watch out for carbon monoxide and cyanide toxicity

# INDICATIONS FOR INTUBATION AND MECHANICAL VENTILATION

- Full thickness burn of the face or perioral region
- Circumferential neck burn
- Acute respiratory distress
- Progressive hoarseness or air hunger
- Respiratory depression or Altered mental state
- Supraglottic edema and inflammation on bronchoscopy

# FLUID RESUSCITATION



# FLUID RESUSCITATION

Modified Parkland
2 to 4 x Weight (Kg) x BSA%

# INDICATIONS FOR AN ESCHAROTOMY

## Circumferential chest or neck burns with:

- Increased airway pressures
- Hypoxemia
- Difficulty with ventilation

## Circumferential extremity burn with:

- Pain, loss of sensation, delayed cap refill (early signs)
- Decreased doppler signal distally
- Pulse oximetry of less than 90% distally in the limb (one study)

distal vascular status of such patients must be monitored closely, including pulses, capillary refill, pulse oximetry, and skin temperature. Doppler flow testing may likewise be useful.

# CRITERIA FOR TRANSFER TO BURN UNIT

**BOX 56.2**

## Criteria for Referral to a Burn Center

Partial thickness burns greater than 10% TBSA
Burns that involve the face, hands, genitalia, perineum, or major joints
Third degree burns in any age group
Electrical burns, including lightning injury (see Chapter 134)
Chemical burns
Inhalation injury
Burn injury in patients with preexisting medical disorders that could complicate management, prolong recovery, or affect mortality
Any patient with burns and concomitant trauma (such as, fractures) in which the burn injury poses the greatest risk of morbidity or mortality
Burned children in hospitals without qualified personnel or equipment for the care of children
Burn injury in patients who will require special social, emotional, or rehabilitative intervention

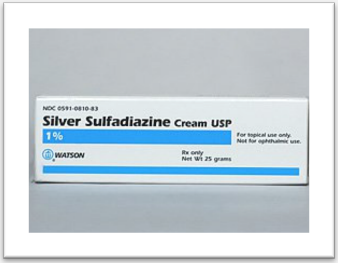
# BASIC BURN DRESSING MANAGEMENT

- ABC's
- Analgesia, analgesia, analgesia
- Prevent hypothermia!
- Assume burns are contaminated: clean and debride gently
- Tetanus toxoid booster if eligible (>5 years since last)
  - If the patient did not complete primary series, TIG
- Leave blisters intact, debride ruptured blisters

# BASIC BURN DRESSING MANAGEMENT

Dressings for partial-thickness burns

- Clearly infected, purulent wounds should be managed in an 'open' manner
  - Topical antimicrobials (e.g. neomycin, mupirocin, silver sulfadiazine)
  - Nonadherent dressing
  - Daily dressing exchange and gentle cleansing with water and soap



# BASIC BURN DRESSING MANAGEMENT

The second method for burn management is with occlusive dressings

- Dressing such as Mepilex or silver-containing occlusive dressing should be applied and left in place for approximately 1 week

# BURN PREVENTION STRATEGIES.

## Flame burn prevention

Secure matches and lighters where they are inaccessible to children

Safety device around fireplace

Create home escape plan and practice with family

Check that smoke detectors are functional

## Scald prevention

Use splash guards on stove

Use thermometer on bathwater

Lower hot water heater maximum temperature to 49-54 C


THANK YOU