IN THE NAME OF GOD

Burn Management

Functions

- Skin is the largest organ of the body
- Essential for:
  - Thermoregulation
  - Prevention of fluid loss by evaporation
  - Barrier against infection
  - Protection against environment provided by sensory information

Types of burn injuries

- Thermal: direct contact with heat (flame, scald, contact)
- Electrical

  A.C. – alternating current (residential)

  D.C. – direct current (industrial/lightening)
- Chemical
- Frostbite

Classification

- Burns are classified by depth, type and extent of injury
- Every aspect of burn treatment depends on assessment of the depth and extent

First degree burn

- Involves only the epidermis
- Tissue will blanch with pressure
- Tissue is erythematous and often painful
- Involves minimal tissue damage
- Sunburn

Second degree burn

- Referred to as partial-thickness burns
- Involve the epidermis and portions of the dermis
- Often involve other structures such as sweat glands, hair follicles, etc.
- Blisters and very painful
- Edema and decreased blood flow in tissue can convert to a full-thickness burn

Second degree burn

- Subdivided into:

1- **Superficial 2nd degree burn;** Very painful burns sensitive to temperature change and air exposure. Typically, they blister and are moist, red, weeping burns which blanch with pressure. They heal in 7 to 21 days. Scarring is usually confined to changes in skin pigment.

2- **Superficial 2nd degree burn;** Blistering or easily unroofed burns which are wet or waxy dry, and are painful to pressure. Their color may range from patchy, cheesy white to red, and they do not blanch with pressure. They take over 21 days to heal and scarring may be severe. It is sometimes difficult to differentiate these burns from full-thickness burns.

Third degree burn

- Referred to as full-thickness burns
- Charred skin or translucent white color
- Coagulated vessels visible
- Area insensate – patient still c/o pain from surrounding second degree burn area
- Complete destruction of tissue and structures
- Healing is very slow, if at all, and may require skin grafting. Severe scarring usually occurs.

Fourth degree burn

- Involves subcutaneous tissue, muscles and bone

Burn extent

 % BSA involved  morbidity

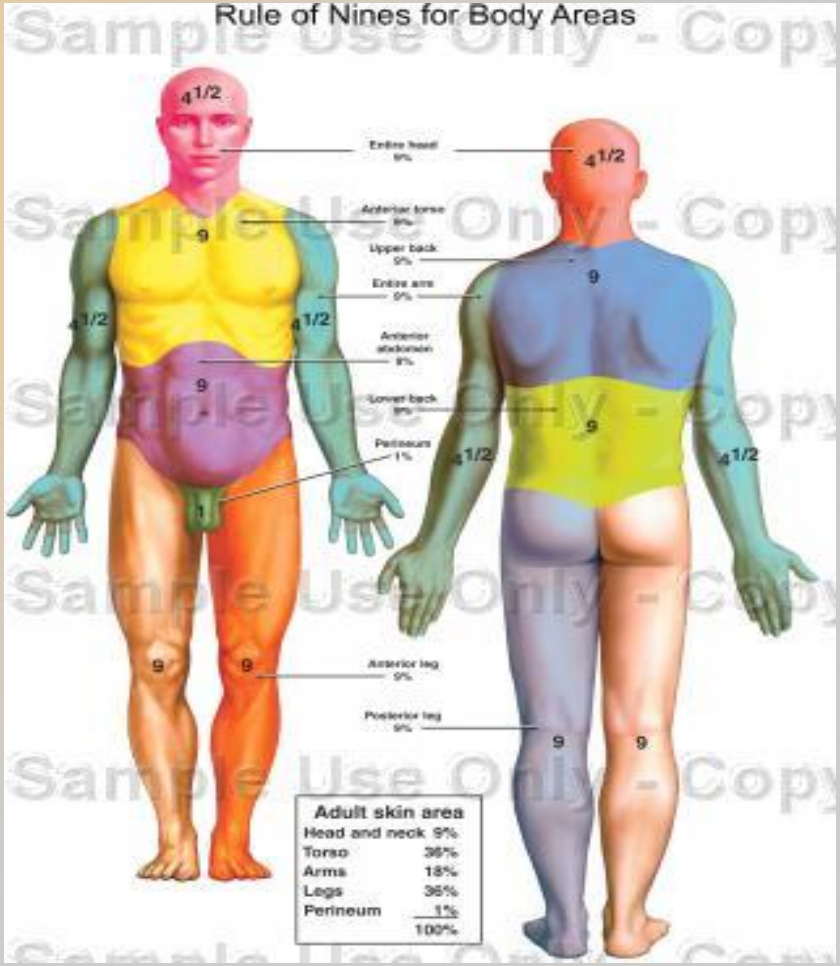
Burn extent is calculated only on individuals with second and third degree burns

Palmar surface = 1% of the BSA

Measurement charts

- **Rule of Nines:**

  Quick estimate of percent of burn

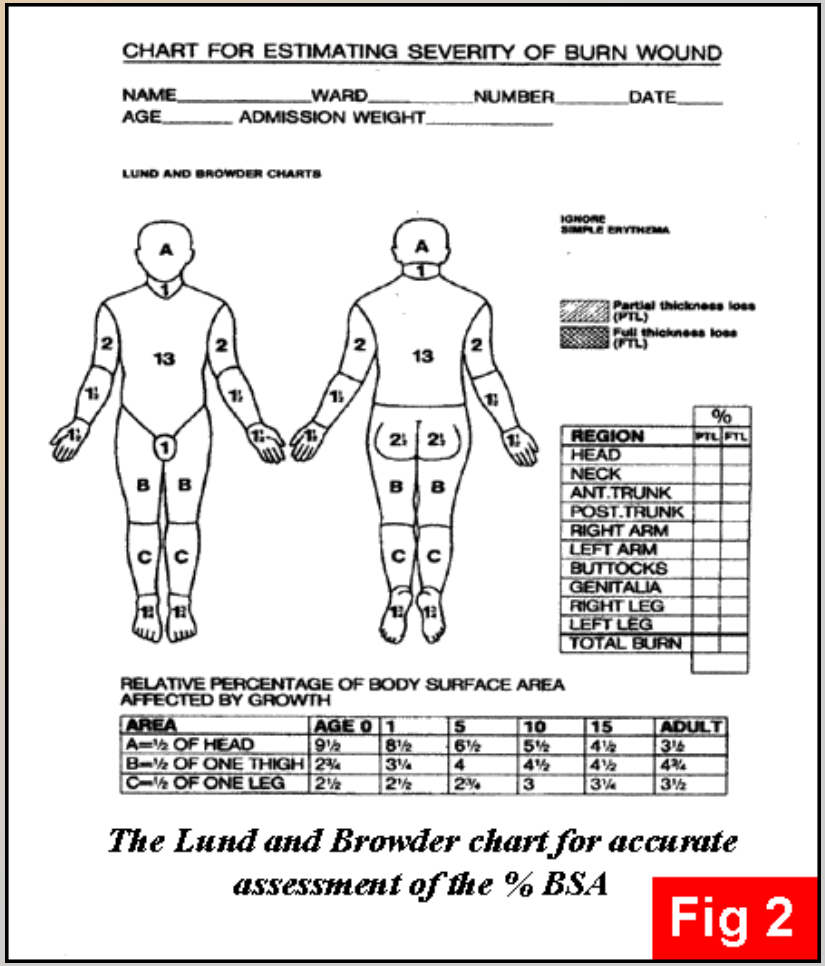


Measurement charts

- **Lund and Browder:**

More accurate assessment tool

Useful chart for children – takes into account the head size proportion.



The Lund and Browder chart for accurate assessment of the % BSA

Fig 2

Measurement charts

- **Rule of Palms:**

  Good for estimating small patches of burn wound

Lab studies

Intermediate and major burns:

- CBC
- Chemistry profile
- ABG with carboxyhemoglobin
- Coagulation profile
- CPK and urine myoglobin (with electrical injuries)

Imaging studies

- CXR
- Plain Films / CT scan: Dependent upon history and physical findings

Complictions

A- Systemic complictions:-

In major burns all body systems may be affected and serious cmoplictions may occur

1- Inhalation injury

2- Neurogenic shock

3- Renal failure

4- Acute duodenal and gastric ulceration, paralytic ileus

5- Multiple organ failure specially with sepsis

Complictions

A- Local complictions:-

1- Early complications

a) Infection; the primary cause of death, from endogenous &/or exogenous sources and may leads to septic shock. Infection usually occurs between 4-7 days postburn

b) Constricting eschar in deep burn of the chest or limbs

2- Late complictions

a) Contracture across joints

b) Scar formation (hypertrophic or keloid)

c) Malignant transformation (Marjolin ulcer) in longstanding unstable scar

Criteria for burn center admission

- **Children < 10 years or adults > 50 years with 2nd or 3rd degree burn>10% BSA**
- **2nd or 3rd degree burn > 15% BSA**
- **Any full-thickness or partial-thickness burn involving critical areas (face, hands, feet, genitals, perineum, skin over major joint)**
- **Circumferential deep burns of thorax or extremities**
- **Significant chemical injury, electrical burns, lightening injury**
- **Co-existing major trauma or significant pre-existing medical conditions**
- **Presence of inhalation injury**

Initial patient treatment

- Stop the burning process
- Consider burn patient as a multiple trauma patient until determined otherwise
- Perform ABCD assessment
- Avoid hypothermia!
- Remove constricting clothing and jewelry

Details of the incident

- Cause of the burn
- Time of injury
- Place of the occurrence (closed space, presence of chemicals, noxious fumes)
- Likelihood of associated trauma (explosion,…)
- Pre-hospital interventions

Airway considerations

- **Maintain low threshold for intubation and high index of suspicion for airway injury**
- **Oedema swelling is rapid and progressive first 24 hours**
- **Prepare for tracheostomy, if needed**

Airway considerations

- **Upper airway injury (above the glottis):** Area buffers the heat of smoke – thermal injury is usually confined to the larynx and upper trachea.

- **Lower airway/alveolar injury (below the glottis):**

  - Caused by the inhalation of steam or chemical smoke.

  - Presents as ARDS often after 24-72 hours

Criteria for intubation

- Changes in voice
- Wheezing / labored respirations
- Excessive, continuous coughing
- Altered mental status
- Carbonaceous sputum
- Singed facial or nasal hairs
- Facial burns
- Oro-pharyngeal edema / stridor
- Assume inhalation injury in any patient confined in a fire environment
- Extensive burns of the face / neck
- Eyes swollen shut
- Burns of 50% TBSA or greater

Ventilatory therapies

- Rapid Sequence Intubation
- Pain Management, Sedation and Paralysis
- PEEP
- High concentration oxygen
- Avoid barotrauma
- Hyperbaric oxygen

Circumferential burns of the chest

- Eschar - burned, inflexible, necrotic tissue
- Compromises ventilatory motion
- Escharotomy may be necessary
- Performed through non-sensitive, full-thickness eschar

Carbon Monoxide Intoxication

Carbon monoxide has a binding affinity for hemoglobin which is 210-240 times greater than that of oxygen.

Results in decreased oxygen delivery to tissues, leading to cerebral and myocardial hypoxia.

Cardiac arrhythmias are the most common fatal occurrence.

Signs and Symptoms of Carbon Monoxide Intoxication

- Usually symptoms not present until 15% of the hemoglobin is bound to carbon monoxide rather than to oxygen.
- Early symptoms are neurological in nature due to impairment in cerebral oxygenation

Carboxyhemoglobin Levels/Symptoms

0 – 5	Normal value
15 – 20	Headache, confusion
20 – 40	Disorientation, fatigue, nausea, visual changes
40 - 60	Hallucinations, coma, shock state, combativeness
> 60	Mortality > 50%

Management of Carbon Monoxide Intoxication

- Remove patient from source of exposure.
- Administer 100% high flow oxygen

Half life of Carboxyhemoglobin in patients:

- Breathing room air 120-200 minutes
- Breathing 100% O2 30 minutes

Circulation considerations

- Formation of edema is the greatest initial volume loss

- Burns 30% or <

  Edema is limited to the burned region

- Burns >30%

  Edema develops in all body tissues, including non-burned areas.

Circulation considerations

- Capillary permeability increased
- Protein molecules are now able to cross the membrane
- Reduced intravascular volume
- Loss of Na+ into burn tissue increases osmotic pressure ⇨ this continues to draw the fluid from the vasculature leading to further edema formation

Circulation considerations

- Loss of plasma volume is greatest during the first 4 – 6 hours, decreasing substantially in 8 –24 hours if adequate perfusion is maintained.

Impaired peripheral perfusion

- May be caused by mechanical compression, vasospasm or destruction of vessels
- Escharotomy indicated with deep circumferential burn affecting distal vascularity

Fluid resuscitation

- **Goal:** Maintain perfusion to vital organs
- Based on the TBSA, body weight and whether patient is adult/child
- Fluid overload should be avoided

Fluid resuscitation

- Lactated Ringers - preferred solution
- Contains Na+ - restoration of Na+ loss is essential
- Free of glucose – high levels of circulating stress hormones may cause glucose intolerance

Fluid resuscitation

- Burned patients have large insensible fluid losses
- Fluid volumes may increase in patients with co-existing trauma
- Vascular access: Two large bore peripheral lines (if possible) or central line.

Fluid resuscitation

- Fluid requirement calculations for infusion rates are based on the time from injury, not from the time fluid resuscitation is initiated.

Assessing adequacy of resuscitation

- **Peripheral blood pressure:** may be difficult to obtain – often misleading
- **Urine Output:** Best indicator unless ARF occurs
- **A-line:** May be inaccurate due to vasospasm
- **CVP:** Better indicator of fluid status
- **Heart rate:** Valuable in early post burn period – should be around 120/min.
- > HR indicates need for > fluids or pain control
- **Invasive cardiac monitoring:** Indicated in a minority of patients (elderly or pre-existing cardiac disease)

Parkland Formula

- 4 cc R/L x % burn x body wt. In kg.
- ½ of calculated fluid is administered in the first 8 hours
- Balance is given over the remaining 16 hours.
- Maintain urine output at 0.5 cc/kg/hr.
- ARF may result from myoglobinuria
- Increased fluid volume, mannitol bolus and NaHCO3 into each liter of LR to alkalinize the urine may be indicated

Galveston Formula

- Used for pediatric patients
- Based on body surface area rather than weight
- More time consuming
- L/R is used at 5000cc/m2 x % BSA burn plus 2000cc/M2/24 hours maintenance.
- ½ of total fluid is given in the first 8 hrs and balance over 16 hrs.
- Urine output in pediatric patients should be maintained at 1 cc/kg/hr.

Effects of hypothermia

- Hypothermia may lead to acidosis/coagulopathy
- Hypothermia causes peripheral vasoconstriction and impairs oxygen delivery to the tissues
- Metabolism changes from aerobic to anaerobic

 serum lactate  serum pH

Prevention of hypothermia

- Cover patients with a dry sheet – keep head covered
- Pre-warm trauma room
- Administer warmed IV solutions
- Avoid application of saline-soaked dressings
- Avoid prolonged irrigation
- Remove wet / bloody clothing and sheets
- Continual monitoring of temperature

Pain management

Adequate analgesia imperative!

Morphine Sulfate

Other pain medications commonly used:

NSAIDs

GI considerations

- Burns > 25% TBSA subject to GI complications secondary to hypovolemia and endocrine responses to injury
- NGT insertion to reduce potential for aspiration and paralytic ileus.
- Early administration of H2 histamine receptor recommended

Antibiotics

- Prophylactic systemic antibiotics are <u>not</u> indicated in the early postburn period.

Nutritional Support

- Essential for wound healing, graft survival; prevents "at risk" partial thickness injury from converting to full thickness injury
- Enteral feeds preferred over TPN
  - may prevent gut→bacterial translocation
  - early (within 4 hours) institution of enteral feeds may achieve early positive N_2 balance
  - may be precluded by paralytic ileus

Nutritional Support

- Multiple formulas for caloric requirements
- Curreri Formula:
  - calories/day=(wt in kg) (25) + (40) (%BSA)
  - needs periodic recalculation as healing occurs
  - probably overestimates caloric needed
- Weight loss of more than 1% of baseline wt per day should not be tolerated for more than ~5 days before progressing to the next level of nutritional support

Other considerations

- Check tetanus status – administer Td as appropriate
- Debride and treat open blisters or blisters located in areas that are likely to rupture
- Debridement of intact blisters is controversial

Treatment

1. **Treatment should begin immediately to cool the area of the burn. This will help alleviate pain.**
2. **For deep partial-thickness burns or full-thickness burns, begin immediate plans to transport the victim to competent medical care. For any burn involving the face, hands, feet, or completely around an extremity, or deep burns; immediate medical care should be sought. Not all burns require immediate physician care but should be evaluated within 3-5 days.**
3. **Remove any hot or burned clothing.**

Treatment

4. Use cool (54 degree F.) saline solution to cool the area for 15-30 minutes. Avoid ice or freezing the injured tissue. Be certain to maintain the victim's body temperature while treating the burn.

5. Wash the area thoroughly with water. Dry the area with a clean towel. Ruptured blisters should be removed, but the management of clean, intact blisters is controversial.

6. If immediate medical care is unavailable or unnecessary, antibiotic ointment may be applied after thorough cleaning and before the clean gauze dressing is applied.

Special considerations

Scalding-typically result from hot water, grease, oil or tar. Immersion scalds tend to be worse than spills, because the contact with the hot solution is longer. They tend to be deep and severe and should be evaluated by a physician. Cooking oil or tar (especially from the "mother pot") tends to be full-thickness requiring prolonged medical care.

a. **Remove the person from the heat source.**

b. **Remove any wet clothing which is retaining heat.**

c. **With tar burns, after cooling, the tar should be removed by repeated applications of petroleum ointment and dressing every 2 hours.**

Special considerations

Flame

a. Remove the person from the source of the heat.

b. If clothes are burning, make the person lie down to keep smoke away from their face.

c. Use water, blanket or roll the person on the ground to smother the flames.

d. Once the burning has stopped, remove the clothing.

e. Manage the persons airway, as anyone with a flame burn should be considered to have an inhalation injury.

Special considerations

Electrical burns: are thermal injuries resulting from high intensity heat. The skin injury area may appear small, but the underlying tissue damage may be extensive. Additionally, there may be brain or heart damage or musculoskeletal injuries associated with the electrical injuries.

a. Safely remove the person from the source of the electricity. Do not become a victim.

Special considerations

b. Check their Airway, Breathing and Circulation and if necessary begin CPR using an AED (Automatic External Defibrillator). If the victim is breathing, place them on their side to prevent airway obstruction.

c. Due to the possibility of vertebrae injury secondary to intense muscle contraction, you should use spinal injury precautions during resuscitation.

d. Elevate legs to 45 degrees if possible.

e. Keep the victim warm until EMS arrives.

Special considerations

Chemical burns- Most often caused by strong acids or alkalis. Unlike thermal burns, they can cause progressive injury until the agent is inactivated.

Flush the injured area with a copious amount of water while at the scene of the incident. Don’t delay or waste time looking for or using a neutralizing agent. These may in fact worsen the injury by producing heat or causing direct injury themselves.