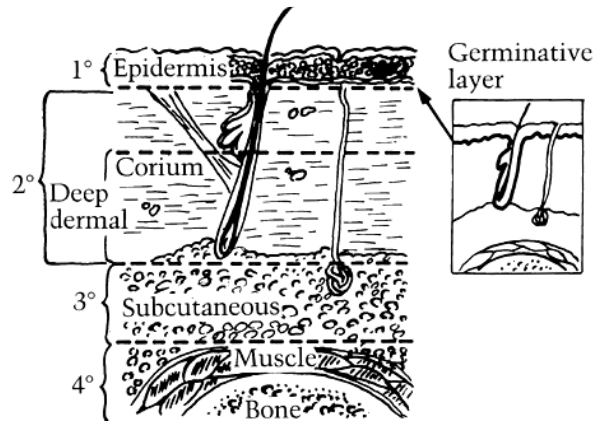


1) Burn – Dr. Jalal

Skin: The skin is the largest organ in the body. Thermal injury to the skin disrupts several vital protective and homeostatic functions as in the table below. *Functions of the skin:*

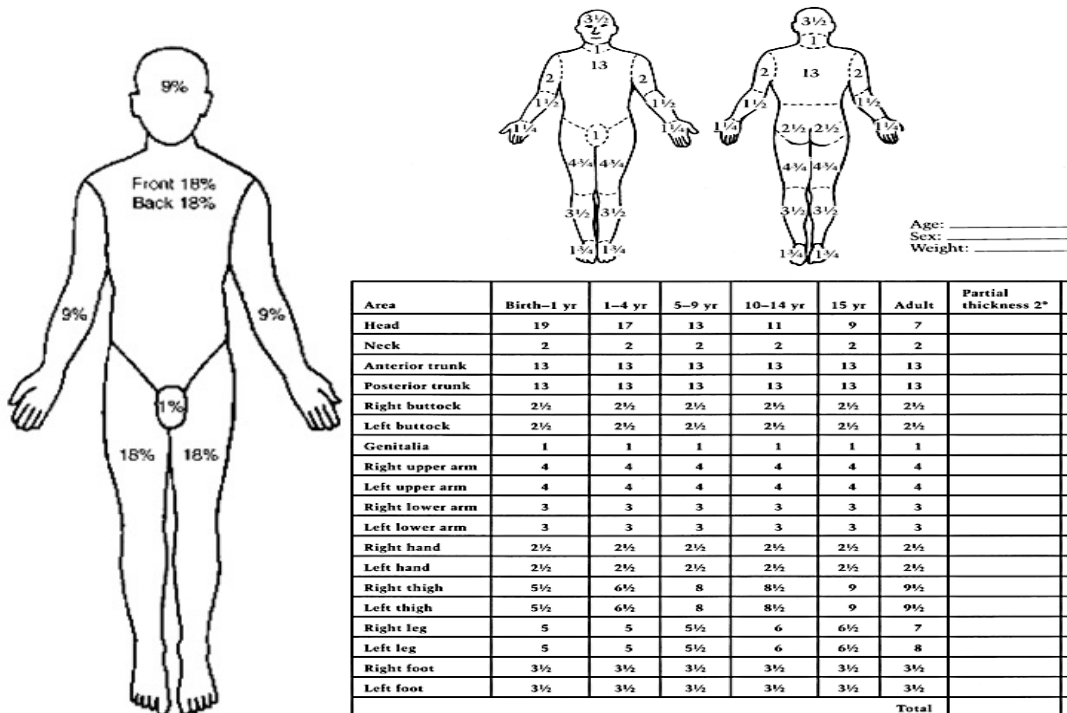
1. Protective Barrier
 - Immunological
 - Fluid evaporation
 - Thermal (insulation, sweat production, vasomotor thermoregulation)
2. Sensory
3. Metabolic (vitamin D synthesis and excretory function)
4. Social (self-image, social image)

Definition of burn: Burn is a wound in which there is coagulative necrosis of the tissue, by direct flame, scalds, chemical agents, electricity, sun exposure, flash flame, friction and irradiation.



Assessment of Burn area

- **Rule of Nines:** This acts as a rough guide to body surface area
- **Lund and Browder chart:** According to the age there is change in the size of head, thighs and legs.
- **Hand size:** 1% (hand and fingers) fingers closed.



I. Superficial Burn (1st degree) e.g.: Sun Burn, Flash flame, involve only the Epidermis.

- No topical Antibiotics needed.
- No blisters (only edema). Erythematous. Dry. Painful and tender due to P.G. production. Healing occurs within 5-7 days. No scar formation.

II. Partial-thickness burn (2nd degree)

- Superficial dermal.
- Deep dermal.

There is destruction of all of Epidermis and variable thickness of dermis and it is divided into:

Superficial dermal

- Heat injury to upper 1/3 of dermis, Light pink, Wet, Very painful with blister formation.
- Healing will occur within 7-14 days by epithelial cell formation from skin appendages.
- Minimal scar formation

Deep dermal:

- Few viable cells remain.
- Slow epithelialization which needs months with scar formation.
- Red mottled with white areas.
- Less moist, Painful, Positive pin prick test.
- Blisters are not characteristic because thick and adherence of dead tissue layer to underlying viable dermis.

III. Full thickness burn (3rd degree)

- Destruction of entire epidermis and dermis.
- Will not heal.
- Color is waxy white (in case of hot fluids) or leathery brown to black (in case of direct flame).
- Eschar with visible coagulate veins.
- Dry, No blisters, No pain (no sensation), Hair pull out easily.

IV. Fourth degree burn

- Involves underlying structures, same finding as 3rd degree burn with involved bone, muscle and tendon.

Importance of amniotic membrane:

- Decreases pain
- Decreases hyper- and hypopigmentation
- Prevents infection
- Enhances healing
- Better visualization of the burn

Escharotomy: is the process of making an incision in circumferential burns to prevent compression and compartment syndrome due to edema which will affect the neurovascular bundle and may lead to gangrene.

Escharectomy: is the process of removal of the eschar (non-viable epidermis and dermis).

Zones of a Burn

Zone of Coagulation:

- Dead tissue.

Zone of Ischemia (Stasis):

- Marginally viable tissue but still viable, the vessels in this area are injured or prone to injury (damaged endothelial cells) lead to mediator release or infection and further decrease in blood flow and converting this zone to non-viable tissue (i.e. the burn changes from 2nd degree to 3rd degree).

Zone of hyperemia:

- Viable tissue responding to injury by inflammation

Severity of burn depends on:

1. Size
2. Site
3. Depth
4. Age Increased mortality in less than two years of age because of
 - a. Increase the surface area
 - b. Immature immune system
 - c. Immature kidneys
 - d. Also increased mortality in patients over 50 years of age because of associated diseases
5. Associated injury e.g. fractures, inhalation injury, head injury, internal bleeding

Severity of burn can be classified into:

1-Major

- PTB (2nd degree) > 25%
- FTB (3rd degree) > 10%
- Burn of critical areas like face, hand, foot, perineum or complex injuries, inhalation injury or other trauma
- Treatment is in burn center

2-Moderate

- Burn of TBSA of 15-25% of 2nd degree or 3-10% of 3rd degree burn
- Usually treated in community hospital

3-Minor

- Total burn <15% of TBSA 2nd degree or less than 3% 3rd degree burn
- Usually treated in ambulatory clinic

Indication for admission

1. PTB > 15% in adult
2. PTB > 10% in child
3. FT B > 10% any age
4. Burn in face, hand, foot, perineum (except minor cases)
5. Inhalation injury
6. Electrical burn
7. Associated major medical illness e.g. DM
8. Other considerations age, home situation and level of cooperation

Electrical burn

- Low tension (less than a 1000 Volts)
- High tension (more than a 1000 Volts)
- High tension damage in both **AC** (Alternating Current) and **DC** (Direct Current) is the same but low tension damage in **AC** is worse than **DC**.

Severity of electrical burn depends on:

- Voltage
- Current
- Type of current
- Site
 - If it passes through the head, it may affect the respiratory center and cause respiratory arrest
 - If the vector passes through the heart it might lead to heart problems or cardiac arrest
 - Bones show high resistance to electricity, they become heated and may damage the surrounding neurovascular bundle
 - If it passes through RBCs it will cause release of hemoglobin
 - If it passes through muscle it will cause release of myoglobin
 - Both hemoglobin & myoglobin will accumulate in the kidney → dark urine
- Duration
- Moisture

NOTE: each case of electrical burn must be admitted for at least 24 hours and we must check urine & ECG

Electrical burn damage by:

- Electrical flash out (actual contact)
- Hotness of wires
- Passage of electrical current (true electrical burn)

Burned skin after healing

- Hypo- or hyper pigmentation
- Scar
- Susceptible for sun burn
- Dry
- Itching

Effects of Burn Injury

- Local effects.
- Regional effects (circulatory problems).
- Systemic effects from burning.

Local Effects

1. **Tissue damage:** Heating of tissue leads to direct cell rupture or cell necrosis. At the periphery the cells may be viable but injured. Collagen is denaturized, and damage to the peripheral microcirculation occurs. Capillaries thrombosed or increased permeability (edematous tissue). External leakage of serous fluid. The difference between PTB and FTB is the depth injury.
2. **Inflammation:** Marked and immediate inflammatory response occur in the areas less damaged by burning. Manifest as erythema. Mild areas of erythema resolve within a few hours. More severely damaged tissue may develop a more prolonged inflammatory response. Macrophages produce inflammatory mediators or cytokines e.g. transforming growth factor- β and neutrophils and later lymphocytes provide protection against infection. Damaged tissue separates by an active cellular process described as desloughing generally completes by 3 weeks.
3. **Infection:** The damaged tissue presents a nidus for infection. Burn wounds will almost inevitably be colonized by microorganisms within 24-48 hours, and this may remain as a local wound or regional infection. Bacteremia. Septicemia. Metastatic infections.

Regional Effects

- **Circulation:** limb circulation may be compromised, direct damage to a main vessel is unlikely except in high tension electrical burn. Gross edema in a limb following burn, the swelling and tissue tension may lead to venous obstruction especially in circumferential burned tissue (Eschar).

Systemic Effects

1. **Fluid loss:** From damage capillaries either by visible external loss or internally into the tissue from edema in the region of the burn or even of the entire body.
2. **Multiple organ failure:** There may be progressive failure of renal or hepatic function or heart failure. The precise cause of the complications is uncertain and may be due to fluid loss, toxemia from infection or uncontrolled over reaction of the inflammatory response to sepsis, MOF may however occur without obvious systemic infection.
3. **Inhalation injury:** Occur in those trapped in closed spaces, particularly common in association with burns of head and neck. Various parts of the respiratory tract may be injured, inhalation of hot gases lead to thermal burn to upper airway, manifest early by stridor, hoarseness, cough, and respiratory obstruction. Inhalation of the products of combustion cause a chemical burn to the bronchial tree and lungs, manifested by hypoxia, acute respiratory distress syndrome and respiratory failure, it may be a delayed onset. Systemic absorption of carbon monoxide (CO) and hydrogen cyanide from burning plastic causes poisoning. CO displaces oxygen from hemoglobin to form carboxyhemoglobin reducing the oxygen carrying capacity of the blood and it also has intracellular effects, the patient may arrive confused or unconscious.
4. **Systemic complications:** well documented systemic complications in association with burns include: Curling ulcer (gastric or duodenal) leading to acute hematemesis. Immune suppression which increase the rate of septic complications. Weight loss due to catabolism (response to trauma)
5. **Nonspecific complications:** include UTI from catheterization. DVT and pulmonary embolism.

Clinical Picture of Burn Injuries

1. **Pain:** Is immediate, acute and intense with superficial burns, persist until strong analgesic is administered.
2. **Acute Anxiety:** the patient is severely distressed at the time of injury. It is frequently to patient to run or in an attempt to escape and secondary injury may result.
3. **Fluid loss and dehydration:** if replacement is delayed or inadequate the pt may be clinically dehydrated.
4. **Local tissue edema:**
 - *Superficial burn:* blister
 - *Deep burn:* edema formation in the subcutaneous spaces then may be marked in head and neck, with sever swelling which may obstruct the airway. Limb edema may compromise the circulation.
5. **Special sites:** Burn of the eyes are uncommon in house fires, the eyes may be involved in explosion injuries or chemical burns. Burn in the nose, airway, mouth, upper airway may occur in inhalation injuries.
6. **Coma:** burning furniture is particularly toxic & patient may suffer from CO or cyanide poisoning.

Management of Burn

1. The first priority is the maintenance of the patient airway.
2. Effective ventilation If there is apnea, inhalation injury or CO poisoning do indo-tracheal intubation which will be impossible later when the edema is increased, mechanical ventilator is needed, otherwise tracheotomy or oro-tracheal or naso-tracheal intubation is indicated.
3. Support of systemic circulation Put IV line and start I.V fluid e.g. Ringer Lactate if burn is more than 15% (adult), and more than 10% (children) after doing the rest of the life saving measures take the patient weight and estimate the % of total and calculate the fluid requirement by Parkland formula. Parkland formula = body wt. x % of TBSA x 4. Fluid (type, volume, rate). Ringer Lactate can be given.
4. Look for and manage other complicating life threatening injuries e.g. head injury, pneumothorax, intra-abdominal injury and increased blood loss, these may lead to death more rapidly than the burn itself.
5. Cold water application If done early it leads to:
 - a. Decreased tissue damage.
 - b. Decreased pain.
 - c. Stabilizes mast cells (decreases edema).
 - *Disadvantages* of it , it increases heat loss leads to shivering , increased O₂ + caloric demand, leads to depletion of glycogen store lead to hypothermia and potentiation of shock.
 - *Indications:* for heat neutralization (initially for minutes). Pain relief in second degree (not third degree) burn which is less than 15%TBS.
6. Evaluate the burn wound and look for the most two important conditions:
 - a. Emergent management of inhalation injury is difficult, diagnosis by (history, blood gases, blood carboxy hemoglobin levels) fibroptic endoscopy is very important. Do early endotracheal intubation. If carboxy Hb is increased (more than 10%) give 100% O₂ administration.
 - b. Release of constricting eschar which lead to decrease chest wall movement (respiratory embarrassment) Extremity constriction (compartment syndrome or distal ischemia and necrosis).
 - *Escharotomy:* Should be done throughout the length and depth of the eschar, release of the underlying tissue indicate adequate incision.
 - *Chest Escharotomy:* Only for full thickness burn extend to subcutaneous tissue, by bilateral incision on anterior axillary line in full length and depth of the eschar, if still inadequate chest movement do Chevron incision over the costal margin and join it to the first incision.
 - *Extremity Escharotomy:* Eschar first increase pressure which impedes venous return which lead to further increase pressure lead to decrease arterial flow. Tissue pressure more than 25mm Hg is more than capillary hyper static pressure leads to decreased arterial flow. Escharotomy is indicated when intra-compartment pressure is more than 40 mm Hg. Do it in the midline, avoid ulnar nerve posterior to epicondyle and common peroneal nerve at fibular head. In digits do it in mid lateral line in ulnar aspect of 2nd, 3rd and 4th fingers, radial aspect of the thumb and 5th finger. Escharotomy is painless for full thickness and painful for partial thickness.

7. *Foley's Urinary Catheter*: done in burn more than 25% TBSA. UOP should be not less than 30-50 ml/hr (adult) and 0.5-1ml/kg body wt/hr in children.
8. *NGT*: done in burn more than 25% TBSA. With suction for gastric decompression, because there is chance of paralytic ileus.
9. *Analgesic and Sedation*: in major burn only IV not IM or SC morphine 0.2 mg/kg or into the drip.
10. *Anti-Ulcer Treatment*: gastric or duodenal lesion occur within 48 hrs after burn, give prophylactic ranitidine (H2 receptor antagonist) or give antacids by NGT.
11. *Tetanus Immunization*: all burn injuries considered as contaminated, tetanus prophylaxis is mandatory except in actively immunized patient within one year(0.5 mg tetanus toxoid IM)
12. *Blood Transfusion*: not always indicated in the resuscitation phase, blood is given in the first 24 hrs if there is either preexisting anemia or associated injuries.
13. *Inotropic Support*: if adequate perfusion cannot be maintained given in case of poor ventricular function (elderly or inhalation injury) low dose dopamine leads to increase renal blood flow (2 microgram/kg/min). Moderate dose of dopamine or dobutamine leadto increase contractility and increase COP (2-5 microgram/kg/min).
14. *Oxygen Therapy*: it is important in respiratory injury.
15. *Careful monitoring which includes*:
 - a. monitoring of the general condition or vital signs.
 - b. monitoring of the fluid resuscitation for adequate perfusion.
 - c. investigations for renal, metabolic and hematological condition.
16. *Antibiotics (controversy)*: sometime penicillin prophylaxis given in more than 10% burn to prevent hemolytic streptococcal infection.
17. *Physiotherapy and prevent bed sore*.