# BURN

*Undersupervision of:*

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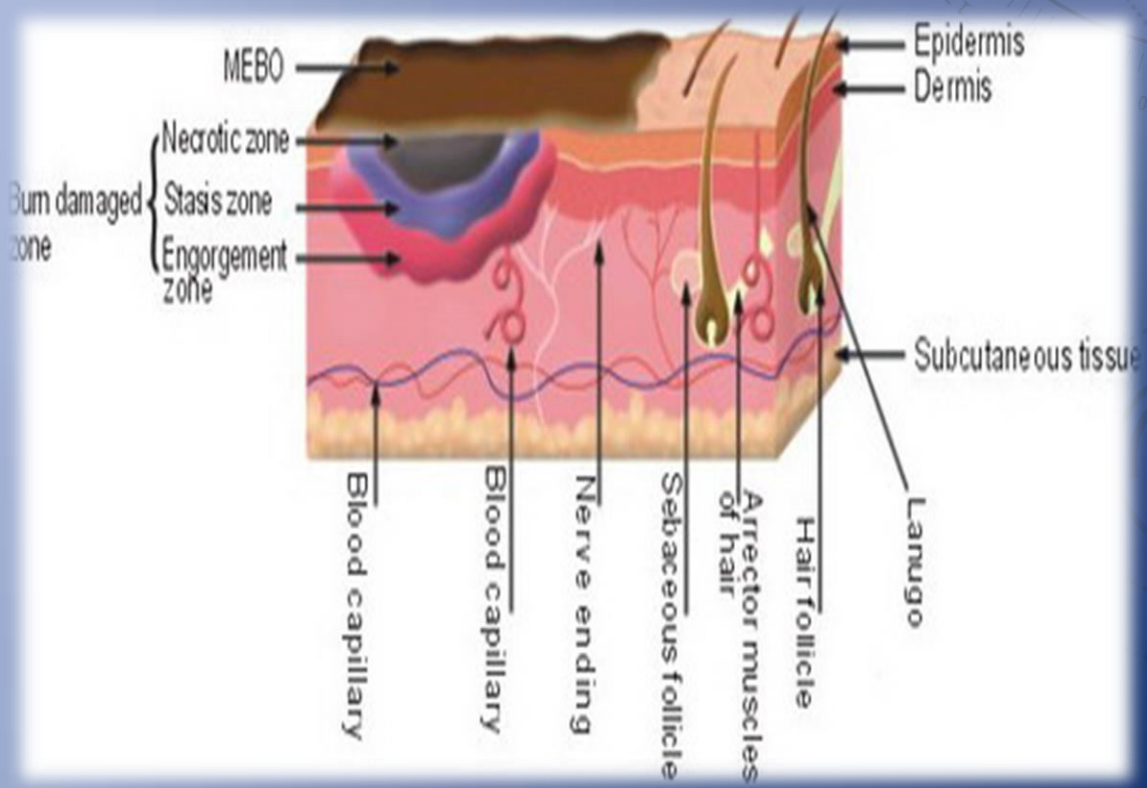
# OUTLINES:

- Definition
- Epidemiology
- Etiology
- Pathophysiology
- Classification
  - According to depth of burn
  - According to extent of burn
- Special burn
- Complication
- Management

# BURN

## Definition:

- Burn is a wound in which there is coagulative necrosis of the tissue.



# Epidemiology:

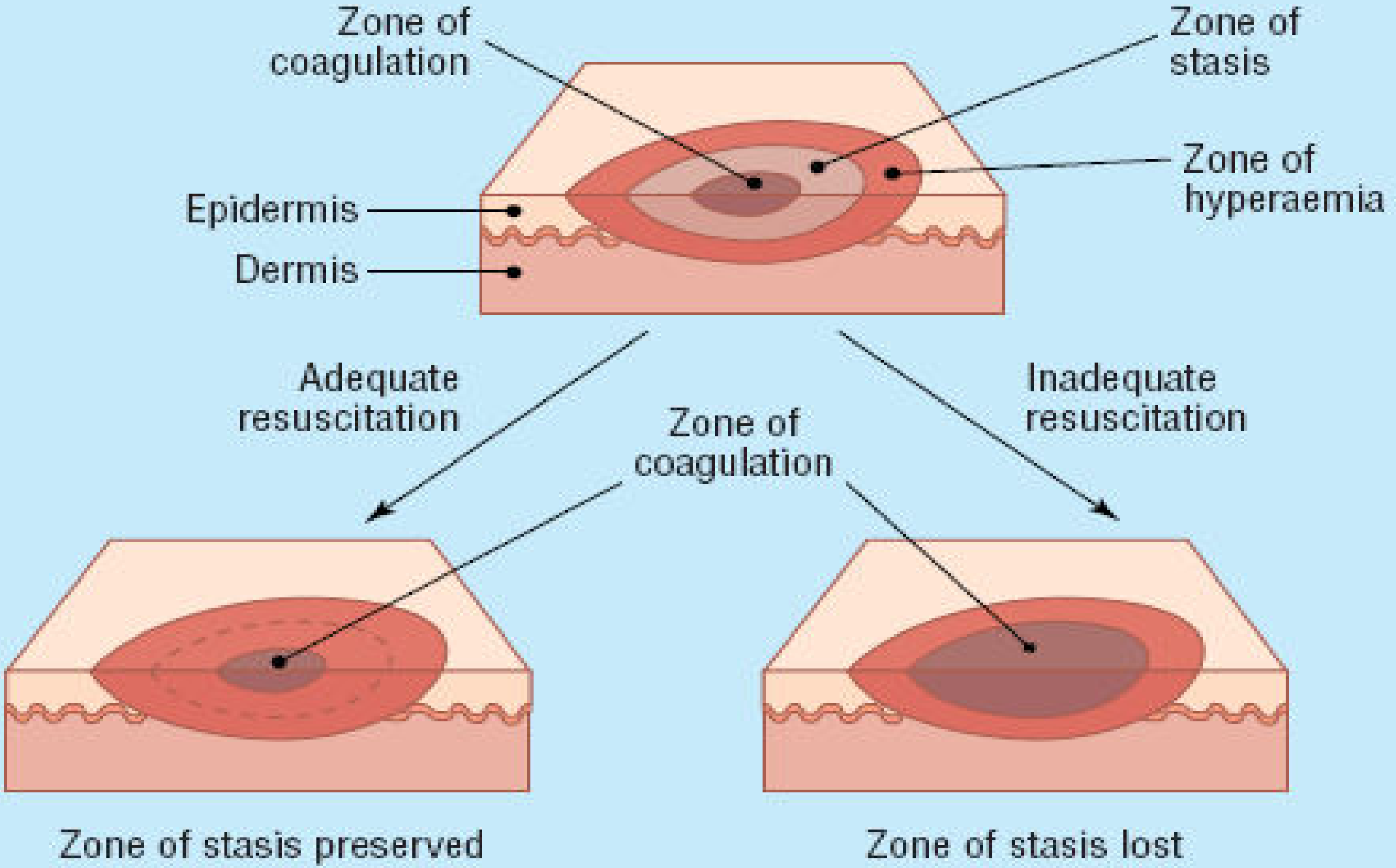
- Burns are one of the most common household injuries. It is estimated that about 450,000 people per year have burn injuries that require medical treatment (American Burn Association, 2013).
- Burns result in about two million physician visits per year (National Library of Medicine, 2014).
- Burns cause about 3000 deaths/year in the US (Merck, 2014)
- Because of the advances in treatment of burns, an individual is now much more likely to survive a serious burn injury and continue to be a productive employee.

# Etiology:

- Thermal extremes (either hot or cold)
- Chemical injury
- Electrical injury
- Inhalational injury
- Radiation

# Pathophysiology:

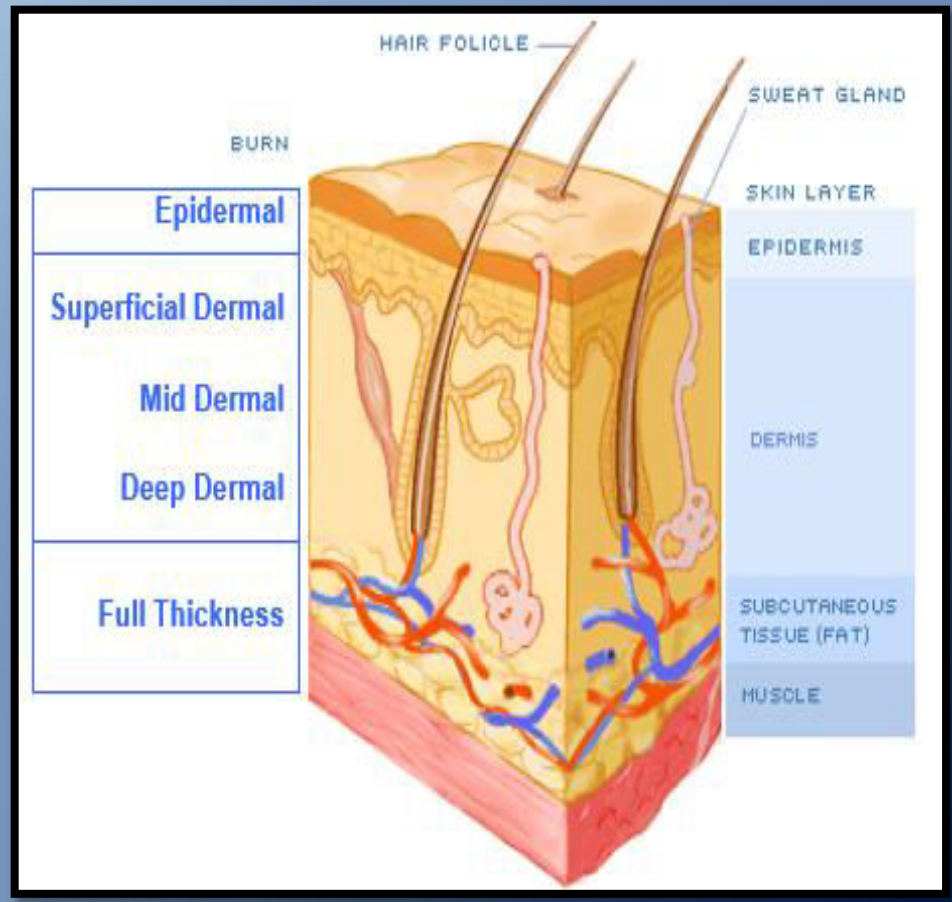
- Zone of coagulation:
  - Irreversible damage, with dead cell
- Zone of stasis:
  - Ischemia and hypoperfusion
  - Recovery variable
- Zone of hyperemia:
  - Increased blood flow via inflammatory vasodilators.
  - Usually recovers


Zone of coagulation
Zone of stasis
Zone of hyperaemia
Epidermis
Dermis
Adequate resuscitation
Zone of coagulation
Inadequate resuscitation
Zone of stasis preserved
Zone of stasis lost

# Burn Classification

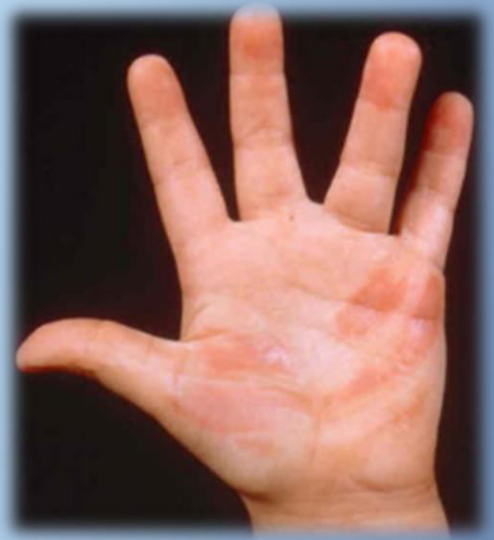
# According to the Depth of burn wound:

- To determine the depth of the injury :
  1. Clinical examination of the burn, including capillary refill.
  2. Source and mechanism of injury, including heat level, chemical concentration, contact time.
  3. Adequacy of first aid (if prompt, will reduce further destruction to zone of stasis.



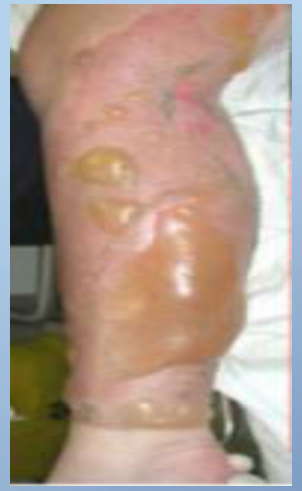
# Epidermal burn: (first degree)

- Limited to epidermis.
- Erythema of skin.
- blanch markedly and widely with light pressure.
- painful and tender.
- Heal without scarring.
- Sunburn.

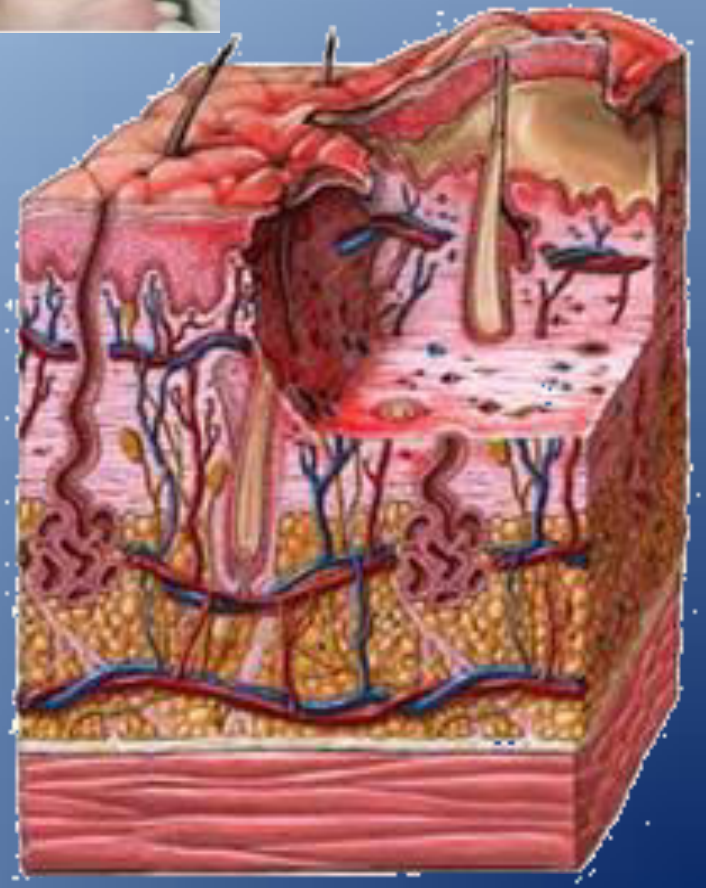


1st degree burn

# Superficial dermal burn (superficial partial thickness) :

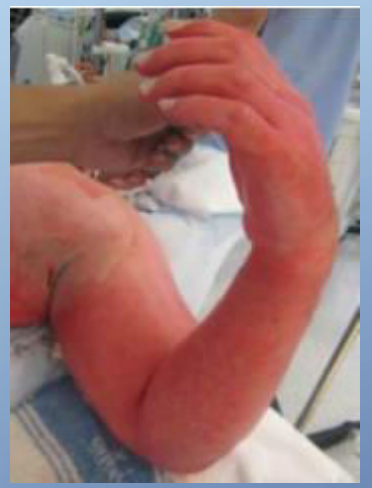


- involve the epidermis and papillary dermis (more superficial) that spares hair follicles and sweat glands.
- Vesicles or bullae develop within 24 h. (The bases of vesicles and bullae are pink and subsequently develop a fibrinous exudate).
- Capillary return normal.
- blanch with pressure.
- painful and tender.
- heal within 1 to 2 wk., and. (Healing occurs from epidermal cells lining sweat gland ducts and hair follicles; these cells grow to the surface, then migrate across the surface to meet cells from neighboring glands and follicles)
- scarring is no or minimal.

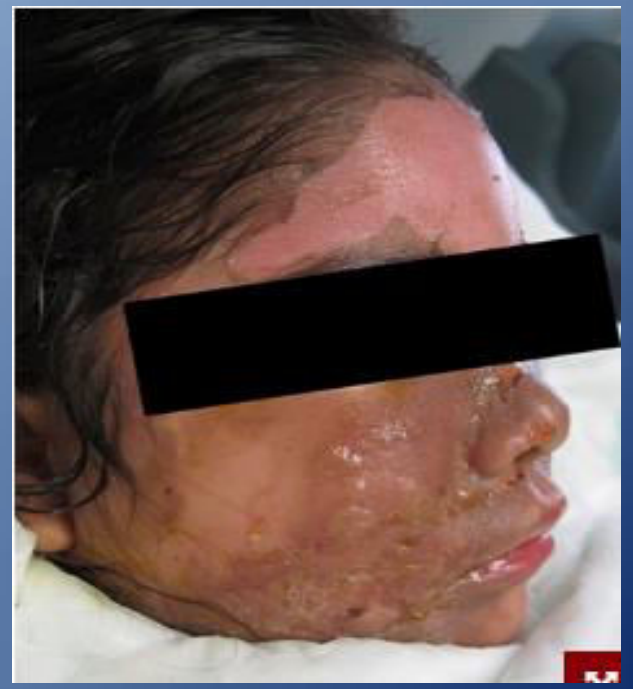


2nd degree burn

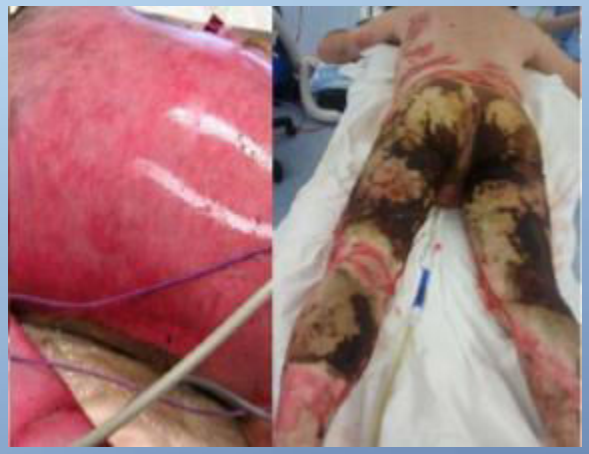
# Deep dermal burn (deep partial thickness):



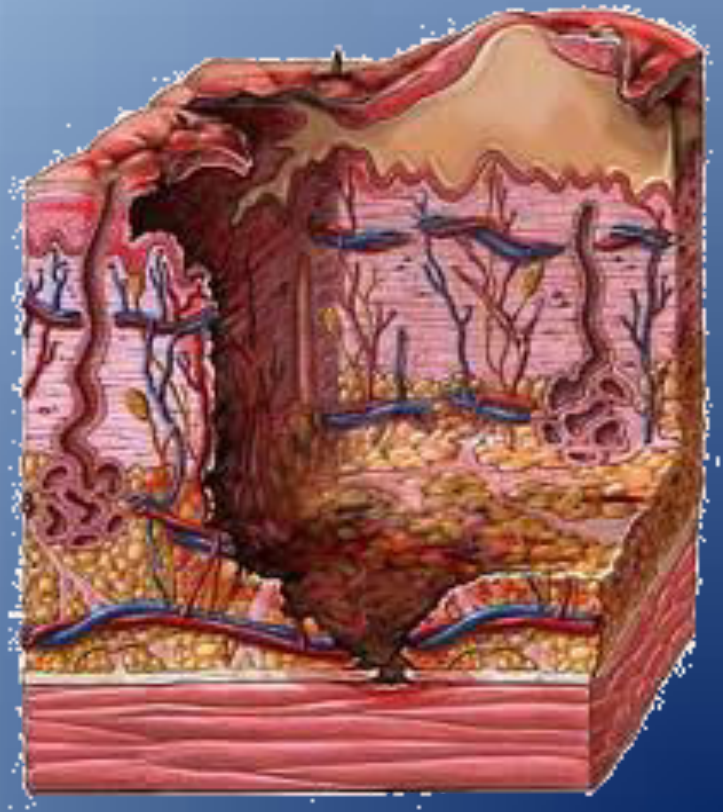
- involve epidermis till the deeper dermis including hair follicles.
- Vesicles or bullae may develop; these burns are usually dry
- white, red, or mottled red and white.
- Capillary return sluggish or absent.
- do not blanch on pressure.
- less painful and tender than more superficial burns.
- take ≥ 2 wks. to heal.
- scarring is common and may be severe.
- Guard against infection.



# Full-thickness burns (third degree burn)



- extend through the entire dermis and into the underlying fat.
- may be white and pliable, black and charred, brown and leathery, or bright red because.
- may simulate normal skin except the skin does not blanch to pressure.
- usually anesthetic or hypoesthetic.
- Hairs can be pulled easily from their follicles.
- Sometimes features that differentiate full thickness from deep partial thickness burns take 24 to 48 hours to develop.
- Healing occurs only from the periphery with risks of scarring and contractures.
- these burns, unless small, require excision and skin grafting.



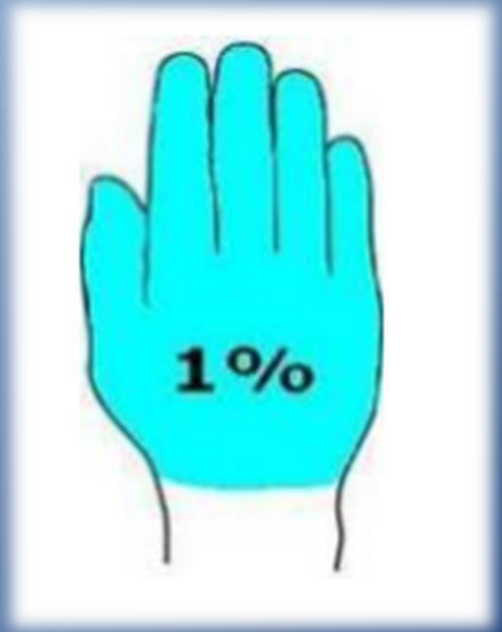
3rd degree burn

# According to the extent of burn

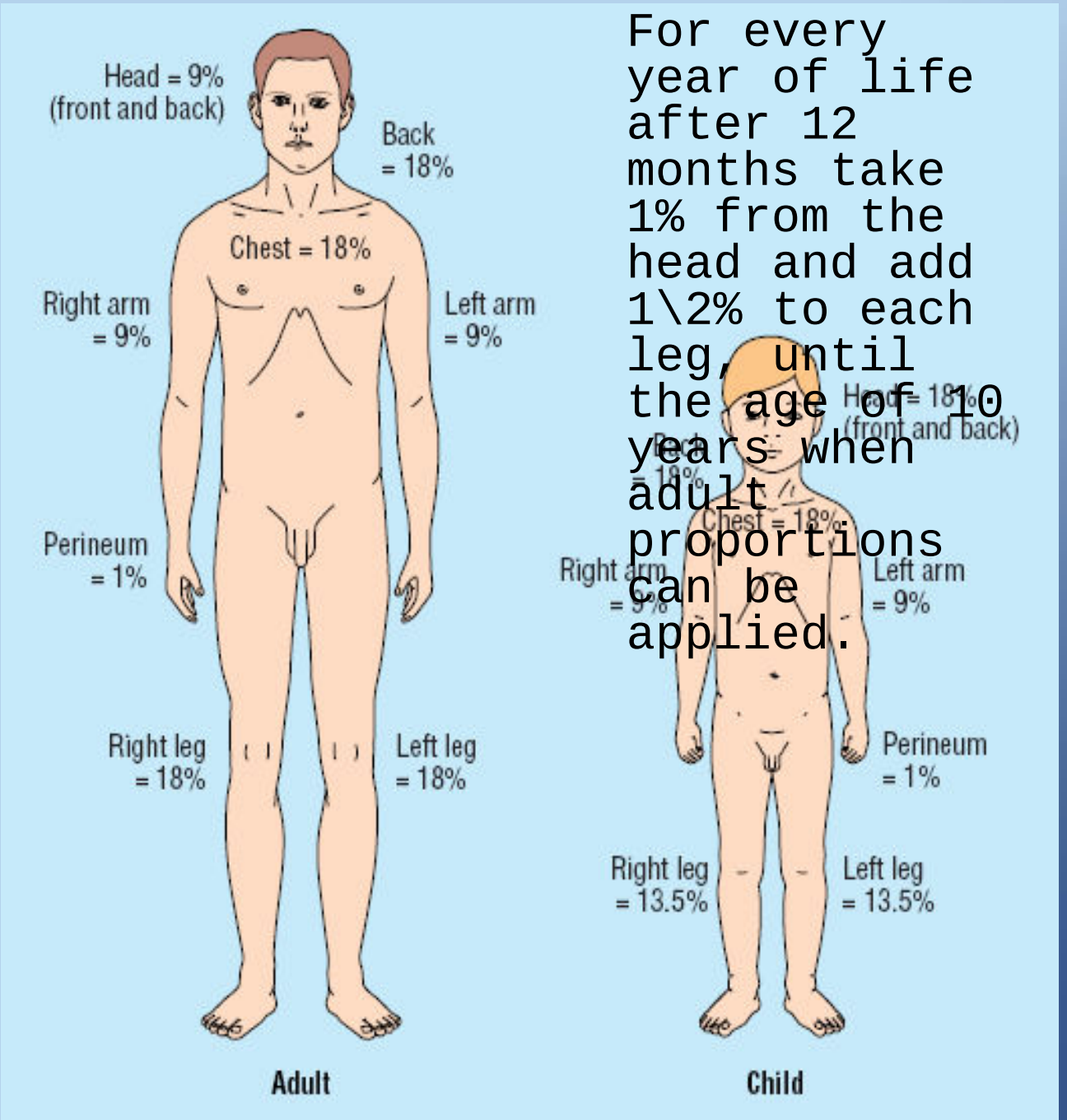
- Palm's method
- Rule of nines
- Lund-Browder Method

First degree burn isn't calculated

- Palm Method:
  - The patient’s palm and fingers closed =1% TBSA.
  - Can be used for small and scattered burns.



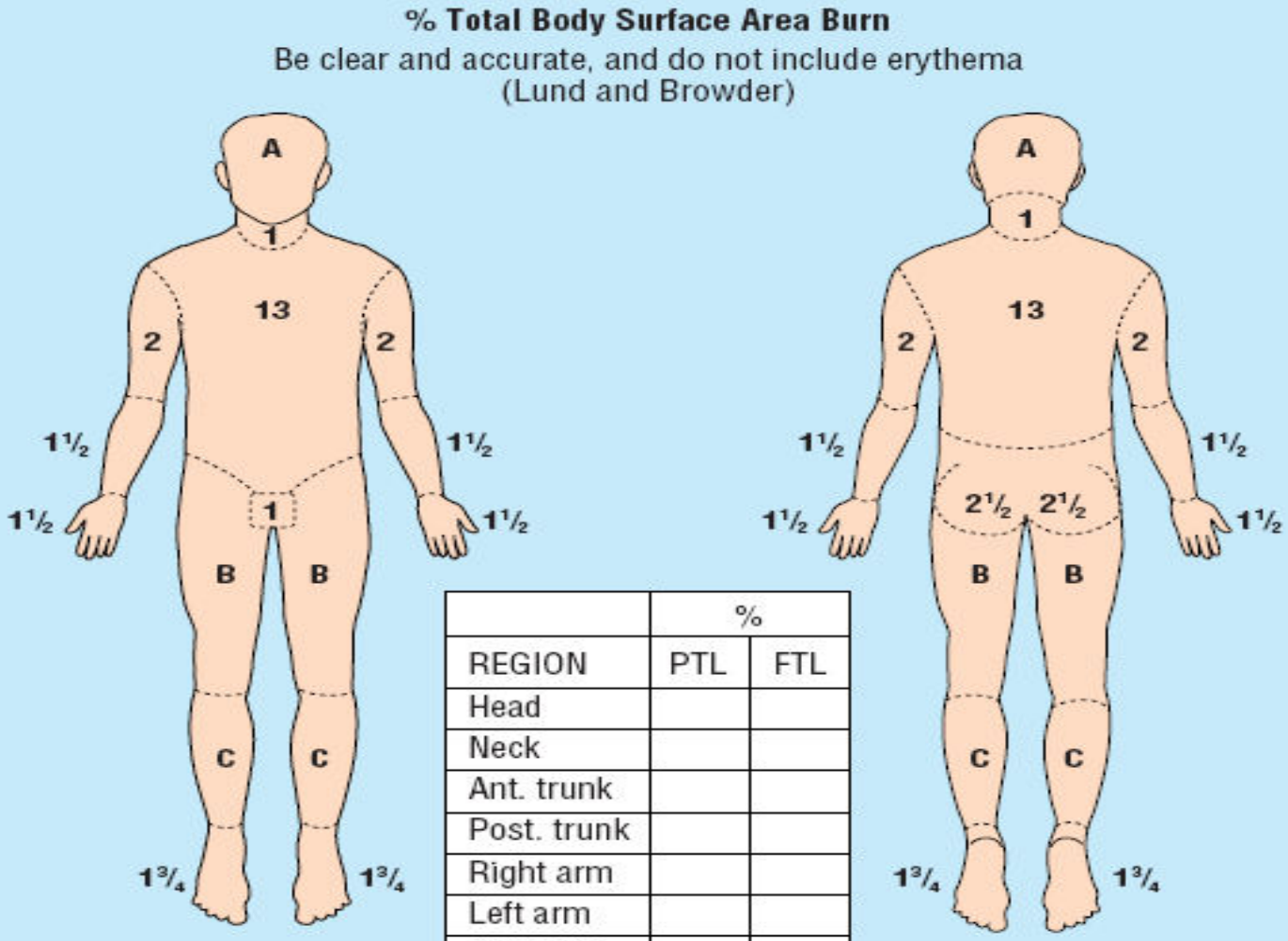
# Rule of nines:




For every year of life after 12 months take 1% from the head and add 1\2% to each leg, until the age of 10 years when adult proportions can be applied.

# Lund-Browder method:

- Can be used for adults, children and infants.
- Most accurate: based on age (growth)




| | % | |
|---|---|---|
| REGION | PTL | FTL |
| Head | | |
| Neck | | |
| Ant. trunk | | |
| Post. trunk | | |
| Right arm | | |
| Left arm | | |
| Buttocks | | |
| Genitalia | | |
| Right leg | | |
| Left leg | | |
| Total burn | | |

| AREA | Age 0 | 1 | 5 | 10 | 15 | Adult |
|---|---|---|---|---|---|---|
| A = ½ OF HEAD | 9½ | 8½ | 6½ | 5½ | 4½ | 3½ |
| B = ½ OF ONE THIGH | 2¾ | 3¼ | 4 | 4½ | 4½ | 4¾ |
| C = ½ OF ONE LOWER LEG | 2½ | 2½ | 2¾ | 3 | 3¼ | 3½ |

# Special burn

- **Electrical injury**
- result from heat generation associated with massive current of electrons(Amount of dissipated heat energy equals amperage$^2$× resistance × time). Electrical burns often cause extensive deep tissue damage to electrically conductive tissues, such as muscles, nerves, and blood vessels, despite minimal apparent cutaneous injury.
- low-frequency AC is more dangerous than high-frequency AC and is 3 to 5 times more dangerous than DC of the same voltage and amperage. Because it causes extended muscle contraction (tetany), which may freeze the hand to the current's source and prolong exposure, but DC exposure is likely to cause a single convulsive contraction, which often throws the person away from the current's source (**Kouwenhoven's factors).**
- **Can cause:**
  - Severe metabolic acidosis.
  - Cardiac arrest or arrhythmias.
  - Fractures of long bone and spine
  - Myoglobinuria with acute renal failure.

- **Chemical burn:**
  - Strong acids (sulfuric acid, carbolic acid…)
  - Strong alkalis (cement, sodium and potassium hydroxide…)
  - Hydrocarbons (kerosene, gasoline…)

*the degree of damage depends on the type of chemicals, its concentration, quantity, duration of contact, and extent of penetration.

*it occurs immediately on contact, but may not be immediately noticeable.

- **Radiation burn:**
  - Prolonged exposure to UV rays of sun
  - Occupational
  - Medical therapies.
- **Inhalational injury:**
  - Burn occurred with a closed space.
  - Burn to face and or neck.
  - Singed nasal hair or eyebrows.
  - Hoarseness, voice changes, wheezing or stridor.
  - Erythema and blistering of oral or pharyngeal mucosa.

  *often requires intubation or mechanical ventilation.

# Complications of burn:

## Local:

1. Infection:
   The main cause of death in thermal injury
   Commonly caused by skin flora
   Topical antibiotics is more effective than systemic ones to guard against infection
2. Hemorrhage
3. Destruction of nerve and paralysis of the muscles supplied by such nerves.
4. Complications of wound healing:
   1. Hypertrophic scar
   2. Keloid formation
   3. Contracture and deformity
   4. Leukoplakia
   5. Malignant transformation (squamous cell carcinoma)

# Systemic:

1. Shock

   Neurogenic (immediately)

   Hypovolemic (within 48hrs)

   Septic (after one week)

2. Metabolic abnormalities

   -Hypoalbuminemia (partly due to hemodilution (secondary to replacement fluids) and partly due to protein loss into the extravascular space through damaged capillaries.

   -Dilutional electrolyte deficiencies can develop (hypomagnesemia, hypophosphatemia, and hypokalemia).

   -Rhabdomyolysis or hemolysis can result from deep thermal or electrical burns of muscle or from muscle ischemia due to constricting eschars. Rhabdomyolysis causing myoglobinuria or hemolysis causing hemoglobinuria can lead to acute tubular necrosis and acute kidney injury.

3. Hypothermia

   result from large volumes of cool IV fluids and extensive exposure of body surfaces to a cool emergency department environment, particularly in patients with extensive burns.

4. Ileus is common after extensive burns.

5. Acute true stress ulcer of stomach & duodenum (curling ulcer

# Management of BURN

- Emergency care for burns.
- General management

# Emergency care for burns:

1. Stop the burning process
   - Remove the patient from the source of injury.
   - If on fire, STOP, DROP, COVER face, and ROLL.
   - Remove hot, scalding or charred clothes.
   - Avoid self-harm during above steps.

## 2. Cool the burn wound

- Cool wound with cold running water for at least 20 minutes to decrease pain.
- Ideal water temperature for cooling is 15$^{o}$C, range 8$^{o}$C to 25$^{o}$C.
- Cooling is effective up to 3 hours after injury.
- Keep the remaining areas dry and warm to avoid hypothermia. (if patient body temperature falls below 35$^{o}$C ,stop cooling
- Chemical burns require copious amounts of water for prolonged periods. Identify the chemical involved. If it is a powder first brush off excess, then irrigate.

**NB:**

Ice shouldn't be used.

Duration should be at least 20 minutes.

Wet towels aren't effective at cooling

## 3. Sterile dressing:

- an appropriate simple dressing for transferring patients with burn injuries to a specialist burns unit.
- that protects against bacterial colonisation and excess fluid and heat loss

# 4. Seek medical advice:

## Criteria for hospital admission:

1. partial thickness burns in adults >10% TBSA
2. full thickness burns in adults >5% TBSA
3. Partial or full thickness burns in children >5% TBSA
4. burns to the face, hands, feet, genitalia, perineum and major joints
5. chemical burns
6. electrical burns including lightning injuries
7. burns with concomitant trauma
8. burns with associated inhalation injury
9. circumferential burns of the limbs or chest
10. burns in patients with pre-existing medical conditions that could adversely affect patient care and outcome
11. suspected non-accidental injury including children assault or self-inflicted
12. pregnancy with cutaneous burns
13. burns at the extremes of age – infants and elderly

# Hospital Management:

A. Airway maintenance:

- It is important to maintain airways patent. Inspect the airway for foreign material /oedema. If the patient is unable to respond to verbal commands, open the airway with a chin lift and jaw thrust.
- Stabilize the neck for suspected cervical spine injury.
- If airway patency is compromised, early intubation is indicated.

## B. Breathing and Ventilation:

- Administer 100% oxygen.
- Expose the chest and ensure that chest expansion is adequate and bilaterally equal (circumferential deep dermal or full thickness chest burn require escharotomy).
- Palpate for crepitus and fracture ribs.
- Auscultate for breath sounds bilaterally.
- Ventilate via a bag and mask or intubate the patient if necessary.
- Monitor respiratory rate (beware if rate <10 or >20 cycles per minute)
- Apply pulse oximeter monitor.
- Consider carbon monoxide poisoning –non burnt skin may cherry pink in color in a non-breathing patient (send blood for carboxyhaemoglobin).

## C. Circulation:

- Inspect for any obvious bleeding- stop with direct compression.
- Monitor the peripheral pulse rate and rhythm.
- Apply capillary blanching test (centrally and peripherally to burnt and non-burnt area). If prolonged, it indicates poor perfusion due to hypotension, hypovolaemia or need for escharotomy on that limb.
- Monitor circulation of peripheries if there is a circumferential burn present. Firstly, elevate the limb to reduce edema and aid blood flow . If this is not effective, then it may be necessary to perform an escharotomy.

## D. Drug therapy:

- Analgesics
- Antibiotics: apply silver sulfadiazine ointment.
- Anti-tetanic serum and immunization:
  - tetanus toxoid booster (0.5 mL SC or IM) is given to patients who have been previously fully vaccinated and who have not received a booster within the past 5 yr.
  - Patients whose booster was more remote or who had not received a full vaccine series are given tetanus immune globulin 250 units IM and concomitant active vaccination.
- Anti-peptic ulcer: (against curling ulcer)

**NB:** This drugs is introduced IV due to

- GI function is impaired because of shock or ileus
- IM injection will not be absorbed well

## E. Exposure and environment:

- Examine the patient properly to adequately determine:
  - Depth
  - Extent
  - Concomitant injuries
- Remove all clothes and jewellery.
- Roll the patient, remove wet sheets and examine posterior surfaces for burns and other injuries.
- Keep patient warm as hypothermia has injurious effect on the patient.

# F. Fluid Resuscitation:

- Required for the patient with burn >10%TBSA for children, >15%TBSA for adults.
- Estimate burn area using role of nines or the palmer method for smaller burn.
- Through 2 large IV lines through unburnt areas.
- Collect blood simultaneously for essential base line bloods –FBC\EUC\LFT\Group\Drug and alcohol.
- Obtain patient body weight in Kgs.
- Parkland Formula:

  3-4ml RL × pt. weight in kgs × %TBSA = IV fluid needs in the first 24hrs following the injury

  1\2 of this volume is given in the first 8hrs

  1\2 of it is given in the following 16hrs.
- Children <30kgs require 5% dextrose \N\2 saline for maintenance fluids in addition to resuscitation fluids

- IV fluids are adjusted each hour according to the previous hour's urine output (the most accurate parameter):

  The urine output should be maintained at a rate

  Adult 0.5ml \kg\hr.

  Child 1ml \kg\hr.

- If urine output <0.5ml \kg\hr. increase IV fluid by 1\3 of current amount and visa versa…….
- More IV fluid are required:
  1. Inhalation injury.
  2. Electrical injury.
  3. Delayed resuscitation.
  4. Fluid loss prior to burn as fire flight, diuretics, alcohol. etc.
  5. myoglobinuria is evident (dark red, black urine). Which occurs if the patient has endured thermal damage to muscle as electrical injury. Mannitol may be ordered .
- Other formula for fluid therapy:

1. Modified Brook's formula

   1st day: (2 ml/kg Ringer Lactate solution X %Burn) + (2000cc glucose for caloric requirement)

   2nd day: (1 ml/kg Ringer Lactate solution X %Burn)+(1/2 ml/kg colloid X %Burn)+(2000cc glucose for caloric requirement)

2. Evan's formula

   1st day: (1 ml/kg normal saline X %Burn)+(1 ml/kg colloid X %Burn)+(2000cc glucose for caloric requirement)

   2nd day: (1/2 ml/kg normal saline X %Burn)+(1/2 ml/kg colloid X %Burn)+(2000cc glucose for caloric requirement)

- Nutrition:
  - Burn patients need more calories and failure to provide will lead to delayed wound healing and malnutrition.
  - Good nutrition decreases risk of infection and improves survival.
  - The use of early enteral feeding in burn patients may attenuate catabolic response after thermal injury.

  So,

  Insert nasogastric \ nasojejunal for larger burns(>20%TBSA in adults, >15%TBSA in children)

  Give calorie containing liquids instead of water.

  Give adequate protein intake. The protein requirement is increased to 1.5-2 g\kg per day in treatment of severely burned patients.

# Secondary Survey:

- **History:** allergies, medications, past illness, last meal and events\environment related to the injury.
- **Mechanism of injury:** ask the patient or others about the following:
  - Date and time of injury, date and time of first presentation.
  - Source of injury and length of contact time.
  - Clothing worn.
  - Activities at time of injury.
  - Adequacy of first aid.

# Local treatment

## Wound dressing:

a. Open (exposed) method:

Technique:

- burnt area left exposed and dusted each 8hrs with antibiotic powder\cream.
- the patient is isolated in completely aseptic condition

Principles:

- The oozing serum forms a crust that prevents 2ry infection.
- Epithelization proceeds under the crust.
- Separation of crust edges occurs gradually until it separates completely leaving an epithelized surface.

Indications:

- Burns of face , neck and perineum
- Burns of one side of trunk or limb

Contraindications:

- Burns of the hands.

Advantages:

- More comfortable to patient (no pain of the dressing change)
- Inhibiting bacterial growth by surrounding dry air

## b. Closed (occlusive) method:

### Technique:

- Clean the burnt area
- Apply silver sulphadiazine ointment
- Dressing with dry vasline guaze.
- The dressing changed every 3 days except:

  -become soaked

  -pain -fever

### Principle:

- Compression to prevent contamination

### Indications:

- Burns of the hands
- Circumferential burns

### Advantages:

- Decrease fluid loss by evaporation
- Decrease pain by covering exposed nerve ending
- Control edema and external oozing by the pressure of dressing

# Surgical treatment:

- indicated for deep partial-thickness and all full-thickness burns (excision of the burnt tissues and covering by suitable skin graft) .
- Escharotomy (incision of the eschar) may be necessary to allow adequate expansion of the thorax or perfusion of an extremity.
- Eschars are removed as soon as possible, ideally within 3 days to prevent sepsis and facilitate early wound grafting, which shortens hospitalization and improves the functional result.
- After excision, grafting proceeds ideally using partial-thickness autografts (the patient's skin), which are permanent.
- When burns are > 40% TBSA and the supply of autograft material appears insufficient, an artificial dermal regeneration template can be used as temporary coverage . Allografts (viable skin usually from cadaver donors) or xenografts (e.g., pig skin) can also be used temporarily; they are rejected, sometimes within 10 to 14 days. Both types of temporary coverage must ultimately be replaced with autografts.
- Fasciotomy is done when edema within a muscle compartment elevates compartment pressure > 30 mm Hg.

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Thank you