MANAGEMENT OF BURN

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Anatomy and functions of skin

- Thermoregulation
- Control of fluid loss
- Mechanical barrier to microorganisms
- Immunological organ
Objectives

- To understand the pathophysiology of burns.
- To know how to evaluate burns.
- To understand the emergency and definitive management of burns.
- To know about complications of burns and its treatment.
What is burn?

Coagulative necrosis of tissues caused by physical injury.
Causes of burns

Thermal

- Increased temperature
  - Hot liquids (Scald) – the most common
  - Flame
  - Contact with hot object
- Decreased temperature - Frost bite
Causes of burns

- Chemicals (acid, alkalis)
- Radiation (UV, X-rays)
- Electricity
Pathophysiology of burn injury

what happens after contact with an injurious agent?
Pathophysiology of burn injury

Zones of injury:
Pathophysiology of burn injury

Zones of injury:

1. Zone of coagulative necrosis: Irreversible tissue damage
2. Zone of stasis: Irreversible tissue damage, progressive tissue damage.
3. Zone of hyperaemia: entirely viable, vasodilatation & increased capillary permeability.
Local effects:

- Inflammatory mediators are released. (histamine, - Prostaglandins, .. )
- These inflammatory mediators result in vasodilatation and increased vessel permeability.
- This leads to fluid loss from the circulation into the interstitial space.
Pathophysiology of burn injury

**Systemic effects:**
- Shock
- Renal failure
- Systemic inflammatory response → multi-organ failure
- Inhalational injury.
- ARDS.
- Septicemia and septic shock
- Hypothermia
- Hypercatabolic state
- Immunosuppression
Pathophysiology of burn injury

Inhalational injury:

- Carbon monoxide (CO) poising (immediately).
- Upper airway obstruction (immediately to 24 hours): inhalation of hot air or chemicals: direct damage of upper respiratory epithelium → edema.
- Pulmonary injury (immediately to days): inhalation of toxic gases → local injuries in the lung.
Complications of burns

**Systemic:**
- Airway obstruction
- Shock (immediate neurogenic, hypovolemic, or septic later).
- Renal failure.
- Pulmonary edema, pneumonia, and respiratory failure.
- GIT: stress ulcer, acute gastric dilatation.
- Multiple organ failure.
- Death.

**Local:**
- Increase in the depth due to insufficient resuscitation.
- Wound infection.
- Healing with bad scars.
Diagnosis of extent of burn

Rule of 9’s:
Diagnosis of extent of burn

- Lund-Browder chart: More detailed chart with percent of each body part for each age groups.
Diagnosis of extent of burn

- Patient’s palm (excluding digits) represents approximately 1% of the TBSA for patchy burns
Diagnosis of depth of burn

- First degree
- Second degree
  - Superficial
  - Deep
- Third degree
- Fourth degree
Diagnosis of depth of burn

- First degree:
  - Epidermis
  - Painful, intact sensation, red, blanchable, erythema.
Diagnosis of depth of burn

- Superficial second degree (superficial partial thickness):
  - Superficial dermis.
  - Painful, intact sensation, blanchable, erythema, moist, thin-walled fluid filled blisters.
Diagnosis of depth of burn

- Deep second degree (deep partial thickness)
  - Deep dermis.
  - Relatively less pain, if blisters found: thick-walled blisters, commonly ruptured, a mixture of red and blanched white, and capillary refill is slow.
Diagnosis of depth of burn

- Third (full thickness)
  - Down to Subcutaneous tissue.
  - Painless, white, gray, black leathery
Diagnosis of depth of burn

Fourth degree:

- Underlying tissues (muscle, bone...)
Healing of burn

- Superficial burn:
  - Outgrowth of epithelial cells from the viable pilosebaceous units and sweat glands.
  - < 3 week, good healing

- Deep burn:
  - Fibrosis
  - 3 week, bad healing (hypertrophied scars, dyspigmentation).
Prognosis

- Burn extent.
- Burn depth.
- Age.
- Location (special concerns):
  - Face, hands, feet, perineum.
  - Circumferential deep burns.
- Concomitant traumatic injuries.
- Electric burn.
- Co-morbidities.
- Associated inhalation injury.
Burn care

- Burn care is multi-disciplinary.
- Burn care networks
  - Pre-hospital care
  - A & E
  - Burn units
  - Burn centers
Prehospital management

- Stop the burning process:
  - Primary survey (ABC).
  - Wound Cooling.
  - Warm the patient.
  - Transport.
Initial management

- Resuscitation
  - Airway
  - Breathing
  - Fluid resuscitation.
  - Analgesia
  - Foley catheter
  - NG tube
  - Escharotomy
- Wound irrigation and dressing – topical antimicrobial
- Stress ulcer, DVT and tetanus prophylaxis
BURN CENTER REFERRAL CRITERIA

- 10% TBSA ( <10y or >50y),
- 20% TBSA in other age groups,
- Significant burn of the face, hands, feet genitalia, perineum, or skin over joints,
- Full thickness >5% in any age group,
- Significant inhalation, electrical or chemical injury.
- Burn with significant preexisting medical problem or severe concomitant trauma
- Burn in patients who will require special social and emotional support
Emergency department management

- Resuscitation
  - Airway
  - Breathing
  - Fluid resuscitation.
  - Analgesia
  - Foley catheter
  - Escharotomy
- Wound irrigation and dressing – topical antimicrobial
- Stress ulcer, DVT and tetanus prophylaxis
Fluid resuscitation

- Indications:
  - Children with burns over 10% TBSA and
  - Adults with burns over 15% TBSA
- Fluid requirements are estimated using standard formulae.
- Daily requirement should be added
- Urine output should be monitored
- Amount of fluid; the rate of transfusion should be modified according to clinical parameters
Parkland formula

- Fluid type: crystalloid
- Total percentage BSA × weight (kg) × 4 = volume (ml)
- Half of the fluid is given in the first 8h after injury. The second half of the fluid is given in the next 16h.
Inhalational Injury

- Immediate intubation if suspected before edema occurs (edema peaks at 12-36 hours).
- High flow 100% moisturized $O_2$: decreases half-life of carboxyhemoglobin.
- Meticulous pulmonary toilet.
- Identify early pneumonia and treat.
Circumferential deep burns of extremity may compress blood supply of the limb, and circumferential deep burns of the chest may impend respiration.

Site: Mid medial and mid lateral of extremities (to avoid major vessel injuries), midaxillary, transverse below the clavicle and subcostal for chest.
Superficial burns (first and superficial second degree):
The aim is to leave the burn to heal spontaneously and prevent burn wound infection.
1. Closed method
2. Open method

Deep burns (deep second and third degree):
Early excision and graft once the general condition permit and after patient resuscitation.
Closed wound dressing

Layers:
1. Layer of antimicrobial agent.
2. Non-adherent layer.
3. Absorbent layer.
4. Retaining compressive layer.

Advantages:
- Prevent cross infection.
- Decrease pain.
- Decrease fluid loss.
- Pressure control edema.
Open dressing

- Frequent application of antimicrobial cream (Silver sulfadiazine cream, mefenide acetate,..).

- Any burn can be treated with the open method. Although burns of special areas as face, neck and perineum where occlusive method is difficult to be applied.

Advantages:
- Easy nursing.
- Less expensive.
Burn excision and grafting

- Two methods of excisions:
  1. Tangential excision
  2. Fascial excision
- After burn excision, the wound is covered with split-thickness skin graft if available or temporarily cover with skin substitutes.
Nutritional support

- Metabolic demand can be increased up to 200%
- Enteral feeding (oral or tube feeding) is preferred to PN.
- Curreri formula: 25 kcal/kg/day + 40 kcal/%TBSA/day is used to calculate caloric requirement.
- The protein requirement is 1.5-2 gm/kg/day.
Physiotherapy, Rehabilitation and After Care:

- To prevent contracture and deformities and treat them.
- Starts immediately.
- Positioning is very important (as for neck, hand, and other joints)
- Early physiotherapy and continue until complete maturation of scars.
- After healing, protect the burnt skin from sun, heat, and friction.
- Hypertrophic scars: pressure garments and silicon sheets.
- Keloids: local injection of cortisone.
- Reconstructive surgery may be needed to correct particularly difficult contractures.
Electrical burns are caused by electricity as it passes through the body and meets resistance from body tissue producing heat.

The heat is proportional to the amperage of the current and the electrical resistance of the body.

**Types:**
- Low voltage (<1000 V)
- High voltage injuries (>1000 V)
Electrical Burns

- Usually there are entry and exit sites.
- Burns extend deeply more than it appears.
- Nerves, blood vessels, and muscles are less resistant and more easily damaged than fat or bone.
- Cardiac arrhythmias, cataract, and spinal cord injury may result.
Additional point in management

- Usually higher resuscitation volumes (hidden tissue damage).
- 24 hours ECG monitoring for cardiac arrhythmia.
- Diagnose and treat compartment syndrome.
- Treatment of myoglobinuria:
  - Maintain UOP 1.5 – 2 ml/kg/hr
  - Diuresis
  - Alkalinization of the urine
Acids

- Cause a **coagulative necrosis**.
- Hydrogen ions will catalyze protein hydrolysis into amino acids.
- Appearance tan to gray discoloration with severe pain.
- Other effects as seen in concentrated sulfuric acid injuries include heat generation and desiccation, producing a mixed injury.
- Acids can be absorbed producing renal and hepatic injury.
Chemical Burns

Alkalis

- Cause liquifactive necrosis.
- Lime, potassium hydroxide, and sodium hydroxide are the most common agents causing chemical injury.
- The degree of tissue injury is dependent on the toxicity of the chemical and the exposure time.
- Alkali burns tend to be worse than acid burns, but systemic effects from absorption are not common.
60 year-old man presented with burn involving both lower limbs (weight 60 kgs):
What is the percentage of burn of TBSA?
Calculate the amount of fluids required in the first 24hrs.
Answer

36 %

4\times60\times36 = 8640 + \text{daily requirement of water (3 Litres)}