Burn

Etiology

Scald burns are the most common cause of burn injury in the civilian population. The depth of scald burn is determined by the temperature of the liquid, the duration of exposure to the liquid, and the viscosity of the liquid (there is usually prolonged contact with more viscous liquids). Scald bums with hot liquids will typically heal without the need for skin grafting. Grease burns, however, tend to result in deeper dermal burns and will occasionally require surgical management.

Flame burns, the next most common cause of bum injury, typically result from house fires, campfires, and the burning of leaves or trash. If the patient's clothing catches fire. burns will usually be full thickness.

Flash burns are quite common as well and typically result from ignition of propane or gasoline. Flash bums will typically injure exposed skin (most commonly face and extremities) and usually result in partial thickness burns.

Contact bums occur from contact with woodstoves, hot metals, plastics, or coals. Contact bums are usually deep but limited in extent of body surface area injured.

In addition. burn injury can result from electrical and chemical agents as well.

Pathophysiology of Burn Injury

1-Local burn injury(skin damage)

2-airway and lungs injury: hot gases can physically burn the upper airway causing laryngeal oedema, and lower airway causing loss of respiratory epithelium. Inhaled smoke particles can cause chemical alveolitis and respiratory failure. Inhaled poisons, such as carbon monoxide, can cause metabolic poisoning. Full thickness burn to the chest can cause mechanical blockage to the rib movement.

3-Inlfammation and circulatory changes: burns produce an inflammatory reaction through activation of the complement system and release of the mediators. This leads to increased vascular permeability and movement of the water, solutes and proteins from the intra- to the extravascular space. As the burn size reaches 10-15% of total body surface area(TBSA), the loss of fluid can produce shock.

4-the immune system and infection : cell mediated immunity is significantly reduced in large burns, leaving them more susceptible to bacterial and fungal infection.

5-changes to the intestine : shock can cause microvascular damage and ischemia to the gut causing malabsorption.

6- danger to peripheral circulation : circumferential full thickness burn to the limb and the leathery eschar may cause ischemia.

Initial Management(emergency treatment):

Burn patients are trauma patients and should be evaluated systematically. The first priority must be maintenance of a patent airway, effective breathing, and support of the systemic circulation :

1-Airway control: endotracheal intubation should be performed on patients who have suffered severe burn, inhalation injury or an upper airway burn. Delayed intubation may become difficult or impossible with the development of burn edema.

2-Breathing and ventilation should be monitored .

3- Circulation: Two peripheral IV lines are usually sufficient for patients with less than 30% burns. However, patients with larger burns or significant inhalation injury will require central line placement.

4- Distant injuries: the next priority in evaluation is diagnosis and treatment of concomitant life-threatening injuries, like head, neck, chest, abdomen and long bones injuries.

5-Exposure : complete exposure to determine the extent and depth on burn

6- taking oral history of the circumstances of the injury is valuable in searching for associated trauma, possibility of presence of inhalation injury, pre-existing medical conditions , medications taken and allergies.

7- radiological examination of the neck , pelvis , and chest will aid in the evaluation of possible blunt trauma.

When there is indication for admission in burn unit, then the following guidelines should be applied.

8- fluid requirement should be calculated using Parkland formula .

Formula: 4 cc*kg*%TBSA = total fluid to be administered in the first 24 hours.50% of fluid should be given in the first 8 hours, and the other 50% of fluid should be given in the next 16 hours. Fluid should be lactated Ringer solution.

Sample calculation: 70-kg person with a 50% TBSA burn:

4 × 70 × 50 = 14 L of fluid
7 L in the first 8 hours
7L in the next 16 hours
The formula is only a guideline. Fluid administration should be titrated to the urine output.
9- a Foley catheter should be inserted and urine output should be measured hourly. Intravenous fluid should be adjusted to maintain a urine output of 30 to 50 cc's per hour in an adult and 0.5-1 cc/kg/hr. in a child.
10- Nasogastric tube: burns of over 20%-25% TBSA are associated with a paralytic ileus. A nasogastric tube should be inserted and placed for suction to maintain gastric decompression.
11- Analgesia and sedatives can be given as needed, but should be given intravenously only.

12- Tetanus immunization should be determined and updated.
13- The patient must be kept warm during transfer using warm IV fluid and adequate coverings.
14- No topical agents should be applied . The burn wounds should be covered with clean dressing sheet.
15- Inhalational injury: in the presence of a suspected inhalation injury, early intubation is mandatory to prevent the development of respiratory distress. If carboxyhemoglobin (CHgb) is elevated (>10%) , 100 percent oxygen must be administered.
16: circumferential burn and the leathery eschar they produced can be a life- or limb-threatening problem in the chest and extremities. Prior to transfer to burn unit, escharatomies should be performed to incise the full length and depth of the eschar.

Indication of Transfer to Burn Center

1:Second and third degree burns >10% TBSA in patients <10 or >50 years old.

2:Second and third degree burns >20% BSA in other age groups.

3:Second and third degree burns with serious threat of functional or cosmetic impairment that involve face, hands, feet, genitalia, perineum, and major joints.

4:Third degree burns >5% BSA in any age group.

5:Electrical burns, including lightening injury.

6: Chemical burns with serious threat of functional or cosmetic impairment.

7:Inhalation injury with burn injury.

8:Circumferential burns .

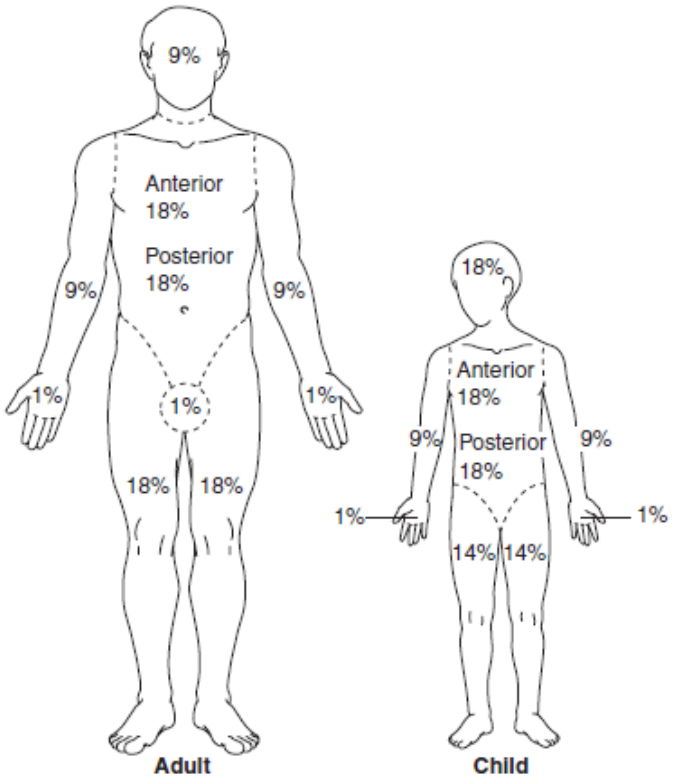
9:Burn injury in patients with pre-existing medical disorders that could complicate management, prolong recovery, or affect mortality.

10:Any burn patient with concomitant trauma.

Determination of Burn Extent

When calculating burned areas from total body surface area(TBSA), only include those areas of partial- and full-thickness dermal injury. Superficial(1st degree) burns involving the epidermis only are not included in the calculation.

The *rule of nines* is the most known method of estimating burn extent. However, it is important to note that the proportions of infants and children are different from those of adults. Lund and Browder charts are anther and more accurate method of assessing burn extent.



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Depth of Burn Injury

The depth of the burn affects the healing of the wound, making assessment of burn depth important for appropriate wound management and, ultimately, the decision for operative intervention.

Superficial(first degree burn) involve the epidermis only and are erythematous and painful. These burns typically heal within 3 to 5 days and are best treated with topical agents such as aloe vera lotion, which accelerate re-epithelialization and soothe the patient.

In addition, oral analgesics can be helpful. Sunburns are the prototypical superficial burns.

Partial-thickness (second degree) burns involve the entirety of the epidermis and a portion of the dermis. The hallmark of these injuries is blister formation. Partial-thickness burns are further divided into superficial and deep based on the depth of dermal injury .

Superficial partial-thickness burns are typically pink, moist, and painful to the touch . Water scald burns are the prototypical superficial partial-thickness wound. These burns typically heal within 2 weeks and generally do not result in scarring, but could result in alteration of pigmentation.
These wounds are usually best treated with greasy gauze with antibiotic ointment.

Deep partial-thickness burns involve the entirety of the epidermis and extend into the reticular portion of the dermis. These burns are typically dry and mottled pink and white in appearance and have variable sensation. Deep partial-thickness burns will heal within 3 to 8 weeks.. However, they will typically heal with contraction, scarring, and possible contractures.
Therefore, if it appears that the wound will not be completely re-epithelialized in 3 weeks, operative excision and grafting is recommended.

Full-thickness burns involve the epidermis and the entirety of the dermis. These wounds are brown-black, leathery, and insensate .Visible thrombosed vessels beneath translucent skin are pathognomonic for full thickness injury. Full-thickness burns are best treated by excision and grafting.

Fourth degree burn involves underlying structures with appearance same as third degree, possibly with exposed bone, muscle, or tendon, and without pain.

Topical Wound Agents

Following admission to the burn center, the patient's wounds should be cleansed with soap and water. Loose tissue and blisters should be debrided. Daily wound care should occur on a shower table with soap and tap water. The choice of topical burn wound treatment is according to the depth of burn injury and the goals of management.

Superficial burn wounds (such as sunburns) require soothing lotions such as **aloe vera** that enhance epithelial repair . Superficial Partial thickness burn wounds need coverage with agents that keep the wound moist and provide antimicrobial protection such as **Bacitracin, neomycin, and polymyxin B .** Deep partial thickness and full-thickness burns wounds should also be covered with a topical agent that protects the burn wound from getting infected until the time of burn excision, such as **Silver sulfadiazine** , **Mafenide and Silver nitrate.**

Fluid Resuscitation

The use of formal fluid resuscitation is reserved for patients with burns involving more than 15% to 20% TBSA. Awake and alert patients with burns less than 20% TBSA should be allowed to resuscitate themselves orally as best as possible.

The purpose of fluid resuscitation is to provide adequate replacement for fluid lost through the skin and fluid lost into the interstitium from the systemic capillary leak that occurs as part of the body's inflammatory response. **Regardless of the type of resuscitation fluid used, urine output is the best indicator of resuscitation**.

Children who weigh less than 15 kg should also receive a maintenance IV rate with dextrose-containing solution because young children do not have adequate glycogen.

Type of fluid:

1-Crystalloid such as RL ,given according to Parkland formula.

2-Colloid such as albumin, Fresh frozen plasma , and dextran.

3-Hypertonic Saline.

Infection

Patients with major burn are immunocompromised, and they are susceptible to infection from many routes. Sterile precautions must be considered . Swabs should be taken regularly. If there are signs of infection, then further cultures needs to be taken and antibiotics started. Increased in white blood cell count and thrombocytosis are warning signs of infection.

Surgical Management

Early burn excision and skin grafting is the standard of care for full-thickness burn wounds.

The benefits of early burn excision are : **increased survival, decreased infection rates, and decreased length of hospital stay**.

Treatment principles for out-patient burn management

1- The patient should examined without clothing
2- Photographs are helpful to follow the progress of the wound and for medico-legal purpose.
3- Wounds should be copiously washed with room temperature saline solution and then with mild soap and a wash clothes.
4- Blisters that have ruptured or appear about to rupture ,should be debrided.
5- After blister debridement, the wound should be covered with moist nonadherent dressing such as xeroform gauze, bacitracin or polysporin. Biological dressing can be used such as Biobrane.
6- If the burn wound is contaminated, or there is devitalized eschar, a topical antimicrobial such as silver sulfadiazine should be used.
7- For wound care, the patient or his family is instructed to remove the dressing once daily, wash gently with mild soap and warm water, and reapply the dressing after cleansing.
8- The patient is seen 24-48 hours after the first dressing to rule out the presence of streptococcal infection. This can be easily treated with short course of oral penicillin.
9- Then the patient should followed at 2-3 day intervals until burn wound heals. All wound treated in this fashion should be totally re-epithelized in 2-3 weeks. If the wound is not re-epithelized in this period , this may indicate that the burn is deep and skin grafting will probably be required.
10- Mild sedatives for the patient(e.g., oral diazepam) with analgesia 30-40 minutes prior to daily dressing should be prescribed.
11- The patient should be advised about possible changes in pigmentation and scarring.
12- Burned skin, after healing , remain highly susceptible to sunburn for a period of 1-2 years. Patients should be advised to avoid excessive sun exposure for several years, protection by physical means(hats, shade, etc.) and sun screens.
13- Burned skin tends to be quite dry and itchy after healing. Skin moisturizer should be used and drying soaps should be avoided. Systemic antihistamine are necessary in more severe cases.
14- Good hand therapist, psychotherapist, and social workers can be of great benefit for burn patient .

Electrical Burn

Electrical injuries are usually divided into low- and high-voltage injuries. Low voltage injuries cause small, localized, deep burns. They can cause cardiac arrest through pacing interruption without significant direct myocardial damage.

High-tension electrical injuries can be caused by one of three sources of damage: the flash, the flame and the current itself. Myocardium may be directly damaged without pacing interruption. The damage to the underlying muscles in the affected limb can cause rapid onset of compartment syndrome, so they may need fasciotomies or amputation. The release of myoglobin will cause myoglobinuria and subsequent renal dysfunction. Therefore, during the resuscitation , effort must be made to maintain a high urine output of up to 2 ml/kg body weight per hour. Severe acidosis is common in large electrical burns and may require boluses of bicarbonate.

Chemical Injuries

There are two aspects to a chemical injury. The first is the physical destruction of the skin, and the first is any poisoning caused by systemic absorption. The more common injuries are caused by either acids or alkalis. Alkalis are usually the more destructive and are especially dangerous if they come in contact with the eyes.

The initial management of any chemical burn is copious lavage with water. The next step is to identify the chemical and its concentration and to elucidate whether there is any underlying threat to the patient's life if absorbed systemically.