Burns: Types, Assessment and Care

2.0 Contact Hours

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Burns: Types, Assessment and Care

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Objectives:

At the completion of this course, the learner will be able to:

1. Recognize the pathophysiology of thermal burns.
2. Specify burn assessment.
3. Identify resuscitative interventions for burns.
4. Identify criteria for referral to a burn center.

Introduction

The American Burn Association estimates that 500,000 people seek medical care for burns and 50,000 are hospitalized yearly. Medical care for burns has progressed to include burn fluid resuscitation, an improvement in care that has accounted for the reduced mortality rate of patients with burns.

Pathophysiology

A thermal burn is an injury to the skin caused by heat reaching at least 113^{o} F (45^{o}C). The area of the skin that receives the greatest amount or duration of heat is the zone of coagulation. In this zone, proteins coagulate, cells die, and the tissue is charred, white, or cream-colored and will not blanch. Surrounding this area is the zone of stasis in which injury varies according to the interruption of blood flow to the tissue. Tissue is red, will not blanch, and may die within 24 hours if fluid resuscitation does not occur. The outermost area of the burn is the zone of hyperemia. Tissue damage in this zone is minimal. The skin is red, blanches, and recovers quickly.

When burns occur, injured cells release mediators that cause increased blood vessel wall permeability. This allows blood components smaller than a red blood cell to escape into the tissues around the burn. Sodium and plasma proteins leak into the tissues leaving the blood very concentrated and viscous. Intracellular sodium, water, potassium, magnesium, and phosphate imbalances occur. In addition, heat causes collagen fibers to break down, allowing skin cells to expand to many times their normal size with edema. The cell membranes are damaged and unless proper fluid resuscitation is given, the cell will burst and die. Hyperkalemia results when cells burst releasing potassium. Fluid loss peaks within 6 to 12 hours after the burn, and then capillary walls begin to recover. Depending on where the burns occur, edema can cause loss of airway, pulmonary edema, abdominal compartment syndrome, or ischemia of an extremity. Systemic inflammatory response syndrome and septic shock can also occur during this time as complications of burns that exceed 15 to 20% surface area.

If aggressive fluid resuscitation is not given promptly for serious burns, a cascade of events occurs that will ultimately be fatal. Hypovolemia results in decreased tissue and organ perfusion throughout the body, especially the skin, gastrointestinal tract, and kidneys. Metabolic acidosis occurs as a result of anaerobic metabolism caused by the decreased blood flow. Abdominal compartment syndrome can cause myoglobinuria, oliguria, ileus, abdominal distension, hypotension, and decreased pulmonary compliance.

Burns propel the metabolism of the body into overdrive which requires the body to increase its oxygen consumption. Hypermetabolism results in muscle wasting, a negative nitrogen and potassium balance, glucose intolerance, hyperinsulinemia, insulin resistance, and retention of sodium.

Types of Burns

In addition to thermal burns described above, chemicals can also cause burns. Those that do so include:

- Strong acids such as sulfuric (toilet and other cleaners), hydrofluoric (glass etching fluid), and muriatic acids (pool cleaner)
- Alkalis such as potassium or sodium hydroxide (oven and drain cleaners), ammonia (detergents), and lime (cement)
- Corrosives such as lye, white phosphorus (fireworks), and phenol (disinfectants)
- Oxidizing agents such as potassium permanganate (disinfectants) and chromic acid (waterproofing agent)
- Vesicants such as those used for chemical warfare including sulfur and nitrogen mustards
- Protoplasmic poisons such as hydrochloric (toilet cleaner), formic (airplane glue), and tannic acids

Most acids cause coagulation necrosis of the skin; alkalis cause liquefaction necrosis. The extent of injury depends on the pH, strength, and amount of the chemical and the length of time that it is on the skin. Systemic effects of the chemical can occur. Some chemicals cause severe heat when diluted so it is important to know how to flush the skin to remove the chemical so that a thermal burn is not added to the chemical one. Adequate flushing can take hours and should be done until pH is normalized. Some chemicals require neutralization. Pain may occur later and radiate from deep within the burn depending on the chemical. Care is the same as for thermal burns.

Electrical burn injuries depend on the amperage, voltage, type of current, path of current, duration of contact, amount of skin in contact, and tissue resistance. Contact with electricity causes coagulation necrosis as the electricity is converted to heat. Wounds are usually small but tissue damage extends deeply into a large tissue area below the wound creating a full-thickness (formerly third degree) burn. Nerves, muscles, and blood vessels are damaged and bone fractures from tetany may also be present.

Ultraviolet radiation from the sun, tanning booths and beds, phototherapy, and arc lamps can cause burns. Blood vessels dilate causing skin to turn red. Mediators are released by cells an hour after exposure, initiating the inflammatory reaction which damages skin cells further. Infrared and ionizing radiation also cause burns by causing breakage in cellular DNA and by programming the cell's early death. Beta radiation used in cancer radiation can cause burns to the skin, called "Beta burns".

Burn Assessment

Burn assessment determines the location of all burns, the classification of each burned area, and the amount of body surface that is burned. Special care is taken to identify entry and exit wounds caused by electricity. Remember that the internal injury under such wounds is usually much larger than the surface wound suggests and may not be revealed for hours or even days.

Burns are classified according to depth of injury. Burn depth is not always apparent until hours or days later when ischemic tissue is identified and removed. Burns tend to be more severe in children and the elderly because their skin is thinner. Burns are classified as follows:

- Superficial partial-thickness (formerly first-degree) - The burn involves the epidermis. The skin is red, may be puffy, and does blanch. Pain is minor, itching occurs with healing. Healing takes 5 days or less.
- Moderate partial-thickness (formerly second-degree) - The burn is down to the superficial dermal zone of the skin. The skin is red or mottled, weeping, and does blanch. Pain is severe. Healing takes 3 weeks.
- Deep partial-thickness (formerly still second degree) - The burn goes down to the deep dermal zone. The skin is pink to cream-colored, may be blistered or dry, and does not blanch. Pain varies from mild to severe. Healing takes 6 weeks.
- Full-thickness (formerly third degree) - The burned area extends through the dermal layer to involve the fat, muscle, and bone below. The skin is white, red, black, or brown, dry and hard, and caved in. Pain is deep and aching. Burn requires grafting to heal which takes more than a month.

The amount of body surface area burned is calculated in various ways. If burns are spotty, use the area of the patient's palm as 1% to estimate size. Another way to estimate is to use the Rule of Nines method. It can be done rapidly to provide estimations used for fluid resuscitation. This method assigns percentages to different parts of the body:

- Head and neck = 9%
- Upper extremities= 9% each
- Anterior thorax=18%
- Posterior thorax =18%
- Lower extremity=18%
- Genitalia=1%

Children have larger heads in proportion to their body so the head and neck region is assigned 18% and the lower extremities are reduced to 14% each; the rest of the body areas correspond to the adult version.

The Lund and Browder formula is more complicated and specific and takes longer to perform. A table lists areas of the body and provides the percentage of the total body surface each area represents at various ages. This table is used at burn centers for more precise calculations.

Resuscitative care

When a patient with burns presents for treatment, a rapid primary evaluation is performed to assess the following:

- Airway
- Breathing
- Circulation
- Disability
- Exposure
- Fluid requirements

When there are burns around the facial area or a suspicion of inhalation injury, edema can quickly compromise the airway. Intubation must be prompt, with emergency cricothyrotomy performed if unable to intubate. The airway must be secured and ventilation begun with 100% humidified oxygen.

Circulation is supported by starting two intravenous catheters of 14 to 16 gauge. Fluid requirements must be calculated using the percentage of the body surface that has at least a partial-thickness (second degree) burn. There is more than one fluid guideline in use for fluid resuscitation of burn patients. One guideline calls for:

- Adults-2 to 4 ml of Lactated Ringers x kilogram of body weight x percentage of body surface area burned over 24 hours
- Children- 3 to 4 ml of Lactated Ringers x kilogram of body weight x percentage of body surface area burned over 24 hours
- Infants and toddlers-Give the above calculated amount of Lactated Ringers for children and add a piggyback of D5W at a maintenance rate.

One-half of the calculated fluid needs of the patient are given within the first 8 hours after injury, with the remaining given over the next 16 hours. Fluid requirements are adjusted during this time according to urine output and the patient's cardiovascular response. A urinary catheter is inserted if the burn covers >20% or there are burns in the genital area so urine output can be accurately measured. If burns are less than 15%, rehydration can be partially via the oral route. Early enteral feedings may be considered at this time also.

Colloids may be given when >40% of the body surface is burned, there is preexisting heart disease or inhalation injury, or the patient is elderly. Whether or not to give colloids such as albumin, Dextran, fresh frozen plasma, or hypertonic saline during fluid resuscitation is being debated as is the amount that should be given. Research on burn resuscitation continues to define the benefits and administration of colloids and also seeks a way to decrease the amount of mediators that are released by burned tissues.

Soon after admission, any burning, smoldering clothing is removed and any chemicals on the skin are rinsed away. Clothing and jewelry are then removed. Wounds are covered with sterile dry dressings or dry sheets if the burned areas are large. Wet saline dressings can chill the patient and should not be used. Tetanus immune status is ascertained and tetanus immunization is administered if needed.

The temperature is taken, monitors are applied, and the patient is kept warm. A nasogastric tube may be inserted if the patient is intubated, burns are more than 20% of body surface area, or nausea and vomiting is present. Intravenous pain medication is given, usually morphine sulfate. Medication for anxiety may also be given.

When the primary interventions are initiated and ongoing, the secondary survey begins. This survey may be done after the patient is transferred to the intensive care unit or to the burn center. It covers assessment of the systems and is burn-specific:

- Neurological-Assess level of consciousness, injuries caused by anoxia or carbon monoxide inhalation, pain, and anxiety.
- Head and throat-Check the eyes and ears for burn injuries or foreign bodies.
- Cardiovascular-Check the chest for breathing restrictions due to burns and edema, evaluate for inhalation injury and give bronchodilators if appropriate. Signs of inhalation injury include singed skin around or in the mouth, smoky odor to breath, cough, hoarseness, wheezes or crackles with respirations, dyspnea, black sputum, and chest pain.
- Gastrointestinal-Check for burns and developing abdominal compartment syndrome: inability to ventilate with decreasing urine output.
- Genitourinary-Assess for burns and need for catheter, assess burns on penis and edema that can cause the uncircumcised foreskin to become trapped below the head of the penis causing constriction (paraphimosis).
- Musculoskeletal-Assess peripheral pulses, sensation, and movement. Monitor for compartment syndrome if burns are circumferential.

Referral to Burn Centers

American Burn Association Guidelines state that the following burn injuries should be referred to a burn center for care after the patient is stabilized:

- Partial-thickness burns over 10% of body surface
- Burns on face, hands, feet, genitalia/perineum, or joints

- All full thickness (third degree) burns
- All electrical burns including lightning
- All chemical burns
- All inhalation injury
- Burn patients with other diseases
- Trauma patients with severe burns
- Burned children
- Burn patients with social and emotional needs
- Burn patients who need rehabilitation

Acute Burn Care

Fluid resuscitation is usually complete within 24 to 30 hours after the burn occurs. Urine output is stabilized at 30 to 50 ml/hr. Vital sign trends slowly show a return towards normal. Abnormalities in serum electrolytes and albumin are corrected. Continued albumin infusions may be used to keep tissue edema controlled and to improve gastrointestinal functioning.

Burn care involves cleansing, debridement, and application of antimicrobial creams. Devitalized tissue must be removed for healing to occur and to prevent the restriction of blood flow in the case of an extremity burn, especially if the burn encircles the limb. Ongoing burn evaluation is performed to guide treatment and monitor for infections. Skin grafting or application of artificial skin may be used to cover large burns.

Pain management is a priority. Nutrition must be supported to allow burn healing to occur. Serum glucose is closely monitored and controlled with insulin administration. Prolonged respiratory support may be needed if inhalation injury is present. Complications such as systemic inflammatory response syndrome, infection, or septic shock are prevented if possible or treated if they occur.

Psychological support is needed as the patient recovers and begins to cope with an altered appearance and any resulting disabilities. Rehabilitation begins when the patient's medical condition is stabilized. Physical, occupational, and speech therapy may be required. Family counseling and financial support is also needed at this time.

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