EMS BURN CARE

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Trauma Injury Prevention/Education
Objectives

• Review the structure and function of the skin
• Identify types of burns
• Discuss pre-hospital management of burn victims
• Discuss inter-facility transport of burn victims
• Discuss inhalation injury, chemical exposure
• Identify patients who need the burn center
• Case reviews
Functions of the Skin

- Skin is the largest organ.
- Functions:
  - Mechanical barrier
  - Protective barrier
  - Sensory organ
  - Temperature regulation
SEVERITY OF BURN

• Burn injury result of
  – Direct injury
  – Inflammatory response
• Severity depends upon
  – Extent
  – Depth
  – Age
  – Associated Injuries/
    Pre-existing illness
  – Hands, face, feet, genitalia
Burn Extent = % Total Body Surface Area

Burn extent is calculated only on individuals with second and third degree burns.

Mortality is effected by:
  - Age
  - Comorbidities
  - %TBSA Burned
Initial Estimate, 2nd & 3rd Degree: "Rule of Nines"
Patient’s palmar surface (hand + fingers)
1% TBSA
Burn Depth

- Temperature of agent
- Duration of contact
- Dermal thickness
- Blood supply

♦ Special consideration:
   Very young or elderly patients
Partial Thickness: First Degree

- Epidermis only
- Pain & redness
- Heals in few days; outer injured epithelial cells peel
- Seldom clinically significant
Partial Thickness: Second Degree

- Entire epidermis & portion of dermis
- Pain, blisters, moist, capillary refill delayed
- Uninjured dermis & epidermis, appendages at risk
Partial Thickness: Second Degree

- May Heal spontaneously in weeks. Epithelial growth from budding surface and wound edges – scarring.
- Skin grafts-improve functional & cosmetic outcome, decrease risk of wound infection.
**Full Thickness: Third Degree**

- Entire thickness of epidermis & dermis
- Decreased pain, dry, absent capillary refill
- May have eschar
What is ESCHAR?

- Dead tissue
- Tan, brown or black
- Slough or crusty like a scab
- Dry, leathery, tough, inelastic. It is like poking cow hide.
How deep are these burns?
How can you tell?
What’s the TBSA?
How deep are these burns?
How many depths of burn are here?
Scald Injuries
CHEMICAL BURNS

Tissue damage factors:
- Concentration
- Quantity
- Contact
  - Manner and duration
- Mechanism of action
- Alkalis
- Acids
- Organic compounds—petroleum products
CHEMICAL BURNS

- Injure the skin
- May be absorbed into the body
  - Damage internal organs
- May be inhaled
  - Lung tissue damage
- May have minimal skin injury and yet cause severe systemic injury

Courtesy of Roy Alson, M.D.
Alkalis / Bases

• pH >7
• May contain hydroxides, carbonates of sodium, potassium, ammonium, lithium, barium, and calcium.
• Oven cleaners, drain and toilet cleaners, fertilizers, stripping agents, cement bonding agent.
• Damage tissue by liquefaction necrosis and protein denaturation ... deeper spread of chemical and progression of the burn. Penetrate more than acids.
Alkali injury to eye

- Vision threatening
- Continuous irrigation using Morgan lens
- May need to numb the eyes
- Be careful where the run off is going...
Acids

• pH < 7
• Bathroom cleaners, calcium and rust removers, swimming pools, masonry cleaning, leather tanning.
• Damage human tissue by coagulation necrosis and protein precipitation, causing think leathery eschar
Organic Compounds

• Phenols, creosote and petroleum products
• Produce contact chemical burns and systemic toxicity

• Cause cutaneous damage due to their solvent action on the fat in cell membranes
• Once absorbed, it can produce harmful effects on the kidneys and liver
Treatment of Chemical Exposure

- BSI precautions.
- Remove and bag all contaminated clothing.
- Brush off dry chemical.
- Flush with copious amounts of water.
- Wipe or scrape any retained chemical and irrigate again.
- Collect runoff water if hazardous.

- Neutralizing chemical contraindicated; potential of heat generation
- Continue irrigation until pain decreases or until patient is evaluated at a burn center
• Remove saturated clothing
• Brush off powder agents
• Continuously irrigate area with copious amounts of water

• Neutralizing chemical contraindicated; potential of heat generation
• Continue irrigation until pain decreases or until patient is evaluated at a burn center
Hydrofluoric Acid – The EXCEPTION

• Will liquefy tissues and leach calcium from the bones
• Go to nearest Emergency Room after flushing with water. Calcium gluconate gel must be applied immediately. 1 amp of Calcium Gluconate mixed with a tube of surgiluble.
Electrical Burns

- Extent of injury depends upon:
  - Type of current; AC/DC
  - Amount of current
  - Path of current
  - Duration of contact

IS THE SCENE SAFE???????
Electrical Tissue Injuries

- Entrance and exit wounds
- Deep tissue injury
- Fractures
- Cannot determine the extent of the burn from the surface burn
Electrical

- Myoglobin is released (due to muscle damage) in high amounts and is toxic to the kidneys.
- Urine becomes tea or cola colored
- Treat with fluids and sodium bicarb infusions.
Electrical Injury

High-flow oxygen. Monitor heart in all patients with electrical contact. Establish IV access. Treat per ACLS guidelines.

- Cardiac arrhythmias are the most serious immediate injury that occurs.
  - V-Fib
    - V-Tach
    - PVCs
Electrical Burns - Initial Care

- Remove rings, jewelry, piercings, watches
- Remove clothing that has not adhered
- Cool burn. Cover in dry dressings or sheets
- Assess skin color, sensation, cap refill and peripheral pulses hourly in an extremity with circumferential burn, an electrical contact, or abnormal neuro exam.
- Watch for compartment syndrome due to muscle swelling
Compartment Syndrome

- Swollen and tight extremity, shiny
- Disproportionate pain
- Tingling to numbness
- Cyanosis
- Loss of distal pulse

- Loss of pulse is a late sign. Often too late!
- Treatment is fasciotomy
Compartments / Pressure Reading

Diagram of human leg compartments:
- Tibia
- Periosteum
- Medial muscle compartment
- Posterior muscle compartment
- Anterior muscle compartment
- Blood vessels and nerves
- Lateral muscle compartment

Image of a medical device being inserted into the leg.
Fasciotomy
Circumferential Burns

- Constriction of tissues under the skin
- Burned tissues swell.
- Dyspnea can develop if around the chest.
- Assess frequently.
- Elevate extremity.
- May need escharotomy.
Signs of Inhalation Injury

- Burns of face or mouth
- Singed facial hair
- Sooty sputum
- Hoarse voice or stridor
- Cough or dyspnea
- History of exposure in enclosed space
Injury Above the Glottis

- Concern for upper airway obstruction
- Pharyngeal edema or burns &/or stridor: high likelihood of airway obstruction
  - Most heat damage occurs above vocal cords
  - Resulting edema severe: may occlude airway
  - Early intubation preferable
INJURY BELOW THE GLOTTIS

- Almost always a chemical injury
- Aldehydes, sulfur oxides & phosgenes adherent to surface of smoke particles cause direct damage to epithelium of large airways

Severity of damage are clinically unpredictable based on history & initial exam
Initial Field Care

- Safety is #1 priority.
- Protect yourself and your patient.
- Rescue of victims from burning structure takes priority over all other treatment!
- Remove patient from source of burn.
Initial Field Care

- Priorities are the same as for other trauma patients.
- Primary Survey first.
  - STOP THE BURNING PROCESS
- Cover burn with clean dry sheet.
- Maintain body temperature.
• Early death is not due to the burn but to…
  – Airway compromise
  – Smoke inhalation
  – Trauma
Airway, Airway, Airway

• Humidified O2 100% non-rebreather mask
• Maintain low threshold for intubation and high index of suspicion for airway injury
• Endotracheal intubation indicated if:
  – Airway obstruction imminent
  – LOC is such that airway protective reflexes are impaired
  – Stridor, wheezing, labored respirations
Can’t tube, lost tube, oh my!

Combitube

LMA

King airway
I think I’m in, I think I’m in . .

- Visualization
- Breath sounds
- Wave Capnography
- Secure it! Hold it! - tie in place. Note lip line.
- Pulse oximetry with CO2 capability
Results in decreased oxygen delivery to tissues, leading to cerebral and myocardial hypoxia.
Cardiac arrhythmias are the most common fatal occurrence.
Masimo Rad 57
Management of Carbon Monoxide Intoxication

- Remove patient from source of exposure.
- Administer 100% high flow oxygen

**Half life of Carboxyhemoglobin in patients:**
- Breathing room air \(120-200\) minutes
- Breathing 100% O2 \(30\) minutes
Circulation considerations

• Formation of edema is the greatest initial volume loss

• Burns less than 25%
  Edema is limited to the burned region

• Burns >25%
  Edema develops in all body tissues, including non-burned areas.
FLUID RESUSCITATION

- **Goal**: Maintain perfusion to vital organs

- Based on the TBSA, body weight

- Fluid overload should be avoided – difficult to retrieve settled fluid in tissues and may facilitate organ hypoperfusion
Fluid resuscitation

- Lactated Ringers - preferred solution
- Contains Na+ - restoration of Na+ loss is essential, Free of glucose – high levels of circulating stress hormones may cause glucose intolerance
- Fluid volumes may increase in patients with concomitant trauma
- Vascular access: Two large bore peripheral lines
- IO only if necessary.
FLUID RESUSCITATION

2ml warm LR x weight in kg x % TBSA second and third degree burns = fluids for 1\textsuperscript{st} 24 hrs
\[ \frac{1}{2} \text{ in } 1\textsuperscript{st} 8 \text{ hrs} \]
\[ \frac{1}{2} \text{ over next 16 hrs} \]

Chronic alcoholics, meth lab injuries, high voltage electrical injuries, or inhalation injuries may require us to double fluid. Let burn center decide.
Resuscitation Response

• Response to fluid resuscitation is determined by **urine output**
  • >30Kg= .5cc/kg/hr
  • <30Kg= 1cc/kg/hr
FLUID RESUSCITATION IN THE FIELD

• IV only if no delay
• NS OK
• Less than 1 hour transport 500-1000 ml, depending on size of the burn.
Drug of Choice: Morphine Sulfate

Dose: As directed

Route: IV Only

PAIN MANAGEMENT
Initial Field Care

- Remove constricting clothing and jewelry.
  - Cut around adherent clothing.
- Do not apply anything to a burn!
- Do not delay transport to start IVs/ fluids.
Effects of Hypothermia

• Hypothermia may lead to acidosis/coagulopathy

• Hypothermia causes peripheral vasoconstriction and impairs oxygen delivery to the tissues

• Metabolism changes from aerobic to anaerobic

serum lactate  serum pH
Prevention of Hypothermia

- Cover patients with a dry sheet
- Pre-warm transport vehicle
- Administer only warmed IV solutions
- Remove wet / bloody clothing and sheets
- Avoid prolonged irrigation
- Paralytics – unable to shiver and generate heat
- Continual monitoring of core temperature
Burn Center Transfer Criteria

- Partial Thickness burns >10% TBSA
- Burns that involve the face, hands, feet, genitalia, perineum, or major joints
- Any third degree burns
- Electrical burns, including lightning
- Chemical burns
- Inhalation injury
- Any patients with both burns and trauma should go to ECMC
- Comorbidities
- Burns that will require social, emotional, or rehabilitative intervention
Upon arrival to Burn Center

- Showered
- Dead skin and blisters removed
- Dressings applied
- Hydration
- Antibiotics
Continued Care

- Shower/whirlpool 1-2x per day
- Debride burns with washcloth or by scraping
- Need beefy tissue with buds.
- Continue until grafts can be applied.
Skin Grafting

- Epidermis
- Split thickness
- Dermis
- Full thickness
Skin Grafting

Graft taken from patient's healthy skin

Skin is meshed to cover a large wound
Skin Source

- **Cadaver** – temporary measure when a patient does not have enough healthy skin to use or burns may progress further.

- **Patient’s own skin** - Preferred. Sites can be reused after 3-4 weeks of healing.

- **Synthetic Skin** - $$$ and more prone to infection.
Graft care

• Grafted skin must be kept moist until graft “takes”
• Mineral oil or A&D ointment to moisten and control itch
• Compression garments to smooth the skin. Lubriderm is used with compression garments.
• Garments are worn 23 hrs per day for a year
Scarring

• Failure to wear garments
• Failure to graft some 2\textsuperscript{nd} degree.
Healed Grafts

- Fragile initially then toughen up
- Sunburn and frostbite easily
- No goosebumps
- Lacerations heal with new scar
- Don’t sweat
- If fat cells destroyed with burn, can’t gain weight in that area.
CASE 1: HISTORY

- 85 year old male
- Sustained extensive burns when he threw gasoline on a trash fire.
- Reportedly, on fire running in the yard before collapsing.

- Extinguished with blankets by a neighbor.
- Most of his body was burned except for most of the head and spotty areas of the trunk and thighs.
WHAT’S THE TBSA?
• How will you determine fluid requirements? He weighs 70 kg.

• Where will you place the IV’s?
WHAT’S THE DEPTH?
HOW CAN YOU TELL?
Circumferential 3rd degree burns are identified on both arms and both legs.

• Why should this concern the medical team?
• Does this patient meet Burn Center criteria?

• How should he be transported?

• How should the wounds be dressed?
Case 2: History

- 48 year old man is cleaning paint brushes with gasoline at a stationery tub in his basement when the water heater pilot light ignites gasoline fumes engulfing him in flames.
HOW DEEP IS THIS BURN?
DOES THIS INJURY MEET BURN TRIAGE CRITERIA?
Case 2: Transport Decisions

• Does this patient meet Burn Center criteria?

• How should he be transported?
• How should the wounds be dressed?
Summary

• Protect yourself and your patient.
• Treat burn patients as trauma patients.
• Stop the burning process.
• Be alert for inhalation injuries.
• Flush chemical burns adequately.
• Monitor heart in electrical burn patients.
• Maintain body temperature.
• Cover with clean dry sheet.
• PCR!
Questions?