




PEDIATRIC BURNS



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ETIOLOGY

- Scalds 65%
- Contact 20%
- Burns >10% should be considered major injury and be evaluated for admission
- Burns with questionable etiology should be admitted to evaluate for child abuse or neglect (20% of admissions are suspicious)

INCIDENCE OF PEDIATRIC BURNS

- 440,000 children/ year seek medical attention (45% of all ED visits for burn)
- 20,000 children require hospital admission (40% of all admissions)
- 1,000 children/year die in house fires
- 2/3 deaths under age 4
- MetroHealth evaluates around 250 burned children/year (1,0000 total patients)



INITIAL MANAGEMENT

- ABC's of ATLS
- Airway
- Breathing
- Circulation
 - estimate of burn size
 - resuscitation formula





AIRWAY

- inhalation injury suspected in close-space fire with smoke exposure
- 100% non-rebreather mask until ABG with COHgb obtained
- evaluate for intubation
- Note: soot in airway, carbonaceous sputum, coughing, etc. are indicators of smoke inhalation; not indications for intubation





AIRWAY

- Children have smaller airways and are more likely to develop edema that will compromise airway
- However a recent paper from the California Shriners Burn Center for Children revealed 30% of children that were intubated prior to transfer did not require intubation
- Several of these children had complications of the intubation



AIRWAY

Indications for Intubation

- unresponsiveness
- respiratory distress
- hoarseness, stridor
- third degree facial burns
- CO poisoning



AIRWAY

- Scalds to face do not require intubation even if the face swells drastically
- Smoke exposure outside does not result in enough airway injury to require exposure
- 80% of people exposed to smoke in a house fire have minor exposure and do not require intubation even with soot present.



CARBON MONOXIDE

- byproduct of combustion
- history : exposed to closed space fires
- signs : decreased alertness – burns are painful and decreased mental status suggests anoxic injury, CO poisoning, or associated closed head injury
- cutaneous pulse ox monitors interpret COHgb as oxygen saturated hemoglobin and cannot be used to rule out CO poisoning – an ABG with direct measurement of COHgb is required

CARBON MONOXIDE

Half-life

room air : 240 minutes

100% oxygen : 30-45 minutes

Hyperbaric oxygen : 15-20 minutes

Pathophysiology

impaired oxygen delivery (COHgb)

impaired oxygen utilization (cytochrome oxidase)

CARBON MONOXIDE

CO levels:

- Urban area (METROHEALTH ED)-2-3%
- 2 ppd cigarettes- 5-6%
- After my cigar and scotch tonight-10% (it's worth it)

CARBON MONOXIDE

Treatment

- intubate/100% oxygen:
COHgb > 20 if symptomatic
COHgb >30
- wean oxygen when:
COHgb < 10 and serum bicarbonate > 20
Resolution of metabolic acidosis signifies CO has cleared the mitochondrial cytochrome oxidase system

CARBON MONOXIDE

- 7 randomized studies of hyperbaric oxygen vs. intubation with 100% oxygen and none have demonstrated improved survival with hyperbaric oxygen.
- The American Burn Association does not recommend that patients with critical burns receive hyperbaric oxygen due to the risk of death in the chamber in these unstable patients

SMOKE INHALATION INJURY

- determinants of mortality : age, burn size, presence of inhalation injury
- leading cause of death at scene : anoxic injury
- leading cause of death in burn unit : pneumonia in patients with pre-existing inhalation injury

RULE OF NINES >30 Kg

- head 9%
- each arm 9%
- anterior trunk 18%
- posterior trunk 18%
- each leg 18%
- genitalia 1%
- palm of patient's hand including fingers is approximately 1%

FLUID RESUSCITATION

- Burns $> 15\%$ TBSA require fluid resuscitation
- If burn is $<15\%$ and you are concerned about oral intake, run fluids at maintenance
- Only areas of skin slough are used; pink first degree burn are NOT used in calculation
- LR

FLUID RESUSCITATION

- IV access wherever you can get it
- Pediatric burns may require IO (even through burned skin)
- A child with a 60% burn will be in irreversible shock without IV resuscitation within an hour.
- Femoral area is often unburned

FLUID RESUSCITATION

- Parkland formula (4 ml/kg/% burn) will under-resuscitate small children
- Galveston: 2000 ml/m² TBSA +
5000 ml/m² BSA burn
- Brooke: 3 ml/kg% burn (1/2 in first 8 hours)
- Age < 2 maintenance as D5LR continuous +
3 ml/kg hr (1/2 in first 8 hours)

FLUID RESUSCITATION

- A 30 kg (66 lbs) child with an 80% burn only requires 450 ml/hr initially
- Too much fluid in burned children is clearly more of a problem than too little fluid
- Breslow tape will give estimate of weight, calculate burn size and run at 3 ml/kg/% burn- do not just run them wide open



MONITOR

- The best estimate of adequacy of fluid resuscitation is
- 1 ml/kg/hr <age 2; 0.5 ml/kg/hr >age 2
- Increased fluid will be required if:
 - inhalation injury
 - delay in resuscitation
 - pre-existing dehydration



HYPOTHERMIA

- arrhythmias
- CNS depression
- respiratory depression
- coagulopathy
- vasodilatation
- A large burn goes to room temperature – 72 degrees in air conditioned squad or ED

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SECONDARY SURVEY

- falls
- MVA
- “found down”

WOUND CARE

Immediate transfer

- clean, dry or lubricated dressing
- tetanus
- no systemic antibiotics

Transfer delay > 6 hours

- topical agents

TOPICAL AGENTS

- Systemic antibiotics do not penetrate the dead surface tissue of the burn wound and cannot prevent infection of the necrotic tissue. There is no role for prophylactic antibiotic use in burn patients.
- Topical antibiotics decrease surface colonization and decrease the incidence of invasive infections



TOPICAL AGENTS

- The ideal topical antibiotic would have a broad spectrum of coverage, penetrate necrotic burned tissue, and have minimal systemic toxicities.



TOPICAL AGENTS

Silver Sulfadiazine

- poor penetration
- allergies – Sulfa drug
- transient neutropenia – WBC of $< 1,500$ are not uncommon
- resistant *Pseudomonas* strains exist
- inhibits epithelial healing – should not be used in superficial second degree burns which have minimal risks of infection
- advantage : soothing
overall excellent coverage

ESCHAROTOMY

Incision of skin to relieve compartment pressures.

Indications are circumferential third degree burns and :

- chest : increased peak airway resistance in initial 8 hours
- extremities : decreased pulse signal by doppler
increased muscle compartment pressure
- Large fluid resuscitation

ESCHAROTOMY

- chest : create a “chest piece” by incising over clavicles, anterior axillary line, and 10th ribs
- extremities : lateral and medial limb
avoid ulnar nerve at elbow

ADJUNCTS

- NG tube for burns >20% - gastric ileus is common
- tetanus
- fluorescein eyes if facial burns present
- avoid hypothermia
- beware associated injuries – patients found “down” in fires may have associated injuries from the fall

ELECTRICAL INJURY

- Pediatric electrical injury primarily low voltage
- Low voltage - $<1,000$ volts. May cause death due to ventricular fibrillation at time of contact, but results in little soft tissue damage and no permanent cardiac injury. Often may be treated as outpatient.
- High Voltage - $>1,000$ volts. May result in injury to conduction system of heart and persistent arrhythmias. Significant soft tissue injury with 25% of patients requiring major amputation.

ELECTRICAL INJURY

Systemic complications of high voltage injury

- cardiac injury
- muscle damage with compartment syndromes and rhabdomyolysis
- renal dysfunction secondary to rhabdomyolysis
- damage to peripheral nerves; contact points on head may result in central nervous system injury

ELECTRICAL INJURY

Initial assessment:

- ABC's
- Rule of Nines is not useful since much of the muscle damage lies under unburned skin. A urine output greater than 1 ml/kg/hr is required if rhabdomyolysis is suspected (pigmented urine)
- telemetry

ELECTRICAL INJURY

ADMIT

- High voltage injury
- Significant associated burn
- Syncope at time of shock
- Abnormal EKG
- Majority of children with household “shocks” do not require admission

CHILD ABUSE

- 20% of burns in children are due to abuse/neglect
- 40% mortality if abuse
- Murder is leading cause of traumatic death in children under age 1

CHILDREN AT RISK

- Mentally handicapped
- Chronically ill
- Lower socioeconomic status
- But I have treated lawyer's and doctor's kids for abuse- it is an anger management disorder



SCALDS

Time to partial thickness burn in child

- 140°F: 2 seconds in infant
- 130°F: 6 seconds in infant



EXAM

- Recognizable abuse burn patterns exist
- Growth retardation
- Developmental delay
- Evidence of previous trauma/burns
- Abused children are also neglected



FIRESETTERS

- Adolescents
- Psychological disorder
- Formal counseling programs exist

