Prehospital Care of Pediatric Burns

Stacey F. Noel, M.D.
Clinical Assistant Professor, Pediatric Emergency Medicine
University of Michigan Health Care System

Objectives

- Epidemiology
- Burn physiology unique to children
- Initial evaluation and treatment of children
- Special burns: eyes, airways
- Immediate complications: compartments, inhalational toxins
- Non accidental burns
- Safety

Introduction

- 3rd leading cause of accidental childhood death
  - MVCs, drowning
  - 120,000 + kids receive ED burn care annually
  - Mortality rate for children admitted to burn centers < 3%

- <5yo: scald injuries
  - 60-80% of all are scalds
- >5 yo: flame/inhalation injuries
  - Preteen and teen males: Firework injuries

Figure 1: Hospital Emergency Room Visits in 2008 for Burns, by Type of Burn

- Electrical, 2%
- Radiation, 5%
- Chemical, 4%
- Thermal contact, 42%
- Thermal burn from flames, 13%
**Mortality**

- Highest for young children
- Inhalational injury associated
- Increases >20 TBSA
- One study found 39% mortality in children with >80% TBSA
  - Kids often survive even BAD burns
- *Time to initiation of resuscitation more predictive of survival than extent or severity of burns*
  - *so every child, regardless of the extent and severity of burns, should be aggressively resuscitated...*5

**Normal skin**

**Burn physiology: skin**

- Heat denatures and coagulates (cooks) protein
  - Irreversible damage
  - Zone of coagulation
- Surrounding, tissue with decreased perfusion
  - Can be salvaged with early resuscitation
  - Zone of Stasis
- Surrounding, tissue with inflammation & *increased perfusion*
  - Zone of hyperemia
Contact time & temperature cause exponential increase in severity

- Thinner skin: deeper burns
- Less fat: less insulation of deep structures
- Developing cognition & mobility: longer contact time
- High SA:V ratio: heat loss!
Burn depth

Superficial partial thickness

Burn depth
Burn depth


Epidermal/third degree: Does not heal. Causes scarring and contractures.

Dermis: Causes scarring and contractures.

Total Burned Surface Area: adults

- Head: 1%
- Front and back: 5%
- Right arm: 3%
- Left arm: 3%
- Right leg: 9%
- Left leg: 9%
- Back: 5%
- Front: 23%
- Right arm: 3%
- Left arm: 3%
- Right leg: 9%
- Left leg: 9%

Note: The total body surface area is 100%.
Estimating TBSA

- Smaller subglottic diameter, cone-shaped airway
  - More susceptible to airway edema
- Faster respiratory rate, Higher minute ventilation
  - Carbon monoxide, cyanide concentrate
- Usually otw healthy!
  - Arrests are almost always due to airway/respiratory compromise!

Respiratory physiology

- Nasopharynx vascularity removes (or adds) heat from/to inspired gas
  - Lungs see “just right” temperature
- Inspired heat concentrated in airway tissues
- Swelling from direct injury, systemic inflammatory response
  - ARDS
- Obstruction may be sudden

Inhalational injury
Ominous airway signs

- Stridor, voice change, hoarse or laryngitic voice/cry, positional breathing
- Severe naso or oropharyngeal edema
- Recall: <6mos old = obligate NOSE breathers!
- Carbonaceous sputum
- Singed nasal hair?
- Soot in nose or mouth
- Severe facial burns
- Burns greater than 20% TBSA
**Cuffed vs. uncuffed?**

- Cuffed ETT may be less harmful than thought.
  - Evidence from elective surgical population
  - Retrospective review of 327 cases of operating room endotracheal intubation for general anesthesia in burned children 0-10 years of age over a 10-year period
  - NOT airway burns
- Kids with uncuffed ETTs more likely to have significant air leak requiring immediate reintubation to maintain adequate ventilation
- No significant differences in post-extubation stridor.

**Ventilation**

- Give supplemental oxygen for all (100% face mask).
  - Especially for closed space flame injuries to decrease CO
- If intubated aim for plateau pressures <35
  - Permissive hypercapnea frequently required
  - Use sufficient PEEP
- 70% will develop VAP
  - elevate the HOB, place NG/OG

**Cardiovascular/circulatory**

- Before school age, can’t increase cardiac contractility
  - reliant on heart rate, preload to increase cardiac output (CO)
  - Fluid dependent
- Little ones with >15% may develop systemic inflammation with capillary leak
  - burn edema, burn shock
  - Can look like sepsis
If >15-20% TBSA involved shock is likely
- Delay in fluid resuscitation >2 hours significantly increases mortality
- Burn shock = distributive (SIRS) + hypovolemic (loss, edema)
- Pulmonary edema, myocardial edema, conversion of superficial into deep burns, abdominal & limb compartment syndrome

Resuscitation fluids
- Parkland formula
- Total fluid = 4 ml/kg x %TBSA
- Give ½ over 8 hours
  - ½ over 16 hours
- Don't forget maintenance!
  - LR preferred.
    - Colloid shows no benefit.

Additional considerations with fluids
- Aim for normalization of VS
- Goal UOP 0.5-1.0 ml/kg/h for <30 kg
- If >>1.0 ml/kg/h uop DECREASE infusion rate
  - Risk of systemic edema & mortality with overresuscitation
- More fluids if
  - deeper burns, inhalation injury, electrical burns, associated trauma, younger age, delayed resuscitation, and concomitant intoxication
  - AVOID HYPOTHERMIA
Burn care

- Stop the burning process
  - THOROUGHLY irrigate chemical burns, cool scalds
  - NO ICE!
- For very limited TBSA involvement a moist sterile dressing should cover all partial, deep and third degree burns
- For TBSA >5-10% sterile, DRY dressings should be applied
  - To avoid greater heat loss and increase the risk of hypothermia
- KEEP WARM!

Access

- TBSA >5-10% will require IV access for fluids, pain control: PIV preferred
  - Central access needed for 15-20% TBSA.
- Choose an extremity unaffected by burns.
  - At least choose an area without or distal to circumferential burns
  - IO is acceptable, noting great care in securing
- Do not apply circumferential dressings or tape

Pain control

- Intervention #1-Cover the wounds!
- Morphine is 1st line unless significant hypotension
- Attempt to stay within recommended dosing parameters
  - Fluid needs increase with more opiates
Compartment syndromes

- Impaired capillary refill, paresthesia, increased pain, decreased pulses
- Peaks 24 hours after resuscitation
- Circumferential burns
- Extremity, abdomen, chest, orbit

Eye injuries: Irrigation!
**Electrical injury: lip**

- Cause?
- Risk of severe bleeding days after injury
- Recall electrical burns often more than meets the eye
- Follow path from entrance to exit

**Who to transfer to a burn center?**

- Age <10 with 10% TBSA
- Age 10 or older with >20% TBSA
- Full thickness >5% TBSA
- Inhalation injury
- Significant burn to face, eyes, ears, genitalia, joints (hands/feet)
- Significant associated trauma
- Children with burns in need of transfer for another reason

**Consider transfer if...**

- Electrical burns, including lightning injury
- Chemical burns
- Burn injury in patients with significant preexisting medical disorders
- Burn injury in patients who will require special social, emotional, or rehabilitative intervention
  - Concern for abuse
Burn patterns suggesting abuse

- Up to 20% of peds burn admissions nonaccidental
- Most common: scalds under age 4
- cigarette burns, electrical burns, pattern burns

Cigarette burns

Pattern burns
Scalds

- Accident or not?
- Immersion lines and skin fold sparring
- Drips, splatters following gravity
- Listen for consistent story
  - Over time, repeat tellings
  - With injury
  - With developmental age of child

Accidental vs. abusive scalds

Safety: Teachable moment!

- Hot water heaters no hotter than 120°F
- Kitchen, bathroom safety
  - Kettles, pan handles, open flame, burners, oven doors
  - Faucets
- Humidifiers
- Stoves, fireplaces, cigarettes
- Electrical cords
Case

Questions...

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Sources


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Photo credits

1. www.vicburns.org.au
2. www.dbtrust.org.uk
3. www.wisegeek.com
4. www.blowms.nmucreative.com
5. www.allaboutchris.org
7. www.med.kufauniv.com
8. www.sciencedirect.com
9. www.ebmedicine.net
10. www.bdd.miliprint.hr
11. www.tummytime.onslow.org
12. www.seconddegreeburnpictures.com
13. www.reskin.eu