Pediatric Burn Management

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Lecture Overview

• Burn statistics and etiologies
• Pre-hospital evaluation
• Anatomy of a burn
• Transfer / treatment guidelines
Lecture Overview

- Burn statistics and etiologies
- Pre-hospital evaluation
- Anatomy of a burn
- Transfer / treatment guidelines
**Burn Statistics**

**Scope of the problem**

250,000 children/yr suffer from burn injuries
(This is 30% of all burns in the US)

30,000 children/yr sustain burns requiring admission to a hospital at a cost of $2.3 billion/yr

10,000 suffer permanent disability

2,500 deaths/yr
(#2 cause of accidental death in children)
CHM Burn Statistics

600 burns admitted annually

CHM is the only children’s hospital in MI with a verified Pediatric Burn Center as designated by the ABA and ACS
### Burn Statistics Cont.....

#### Etiology

<table>
<thead>
<tr>
<th>Agent</th>
<th>Pediatric</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scald</td>
<td>55%</td>
<td>25%</td>
</tr>
<tr>
<td>Flame</td>
<td>30%</td>
<td>55%</td>
</tr>
<tr>
<td>Contact</td>
<td>9%</td>
<td>12%</td>
</tr>
<tr>
<td>Electrical</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Other</td>
<td>4%</td>
<td>5%</td>
</tr>
</tbody>
</table>
Types of Burns – Scald

Scald Burn’s are most prevalent in pediatric patients.
Types of Burns - Flame
Types of Burns – Contact

Contact burn from firework

Contact burn from curling iron
Types of Burns – Electrical

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Types of Burns - Chemical
Lecture Overview

• Burn statistics and etiologies
• Pre-hospital evaluation
• Anatomy of a burn
• Transfer / treatment guidelines
Pre-Hospital Initial Evaluation

- Assess the scene
- Stop the burning process/extinguishing the fire
- Remove the burning clothes and/or chemically contaminated clothes
- Cool synthetic materials retain heat with water
Airway and Breathing
On Scene

- Goal: Secure airway along with adequate oxygenation and ventilation.
  - For burns to the head, face, neck, or circumferentially to the chest should always be provided 100% oxygen.
  - Absolute indications for intubation are:
    - Full thickness burns to face
    - Airway obstruction from glottic edema
    - Carbon Monoxide poisoning w/ neurological changes
    - Massive body burns (circumferential chest burns)
    - Always consider prophylactic intubation in the presence of soot in the airways, singed nasal hairs, hoarseness, or dysphagia.
TBSA and Why It’s Important!

• Children have relatively greater surface area per unit of body weight.

• This means:
  – Child is more in contact with the environment
  – Child has relatively greater fluid needs/Kg body weight
  – Child has greater evaporative water loss/ Kg body weight
TBSA and Why It’s Important!

Pediatric Considerations
- Rule of 9’s not accurate for pediatric patients except teenagers
- Pediatric body surface area varies with age
- Age specific diagrams exist but time consuming and impractical in the field
- Calculating BSA (quick method)
  - Pt palm is roughly 1%
  - Only count 2\textsuperscript{nd} and 3\textsuperscript{rd} degree burns

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Fluid Resuscitation in the Field

- Establishing intravenous access may be difficult
  - PIV can be placed through a burned site
  - IO if less than 4 years of age

- Start LR at
  - 150 cc/hr < 5 yrs
  - 250 cc/hr for 5 to 15 yrs
  - 500 cc/hr for > 15 yrs

DO NOT BOLUS!!!
Thermoregulation

• Keep the patients warm, dry, and covered.
  – Why?
    • Conservation of body heat is compromised by the larger body surface area. (Hypothermia sets in quickly when skin is wet or exposed)
    • Intrinsic heat generation by shivering is hampered by small muscle mass in children.
What to use in the field?

- Clean dry gauze
- Warm blankets
- Consider increasing temperature in the rig

- Remove any wet, cold, soiled dressings that parents or outside facilities may have applied.
  - Do not immerse/soak extremities in water or ice
  - Tea tree oil is not indicated
Lecture Overview

• Burn statistics and etiologies
• Pre-hospital evaluation
• Anatomy of a burn
• Transfer / treatment guidelines
Anatomy of the Skin

- Skin is our largest organ
- Skin functions
  - Protection from infection
  - Water vapor barrier
  - Temperature regulation
  - Sensation
Classification of Burns
First Degree
Classification of Burns
Second Degree

Second degree burn
- Superficial
- Mid dermal (intermediate)
- Deep dermal
Classification of Burns
Third Degree
Classification of Burns
Fourth Degree

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Pathophysiology of Burns

• Depth of burn depends on
  – Temperature
  – Duration of exposure
  – Dermal thickness

• The thinner the dermis – deeper the burn
  – Child vs. Adult
  – Back vs. Face
Pathophysiology of Burns

- Cellular damage at >113 degrees Fahrenheit (45 degrees Celsius)
- Extent of burn depends on temperature and duration of exposure.

**Immersion time to full thickness burn**

<table>
<thead>
<tr>
<th>Temp (F)</th>
<th>Time (adult)</th>
<th>Time (child)</th>
<th>Time (infant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>156</td>
<td>1 sec</td>
<td>Instant</td>
<td></td>
</tr>
<tr>
<td>149</td>
<td>2 sec</td>
<td>Instant</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>5 sec</td>
<td>1 sec</td>
<td></td>
</tr>
<tr>
<td>130</td>
<td>30 sec</td>
<td>10 sec</td>
<td>5 sec</td>
</tr>
<tr>
<td>127</td>
<td>1 min</td>
<td>7 sec</td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>3 min</td>
<td>11 sec</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>10 min</td>
<td>20 sec</td>
<td></td>
</tr>
</tbody>
</table>
Calculating % BSAB Cont.

Patient’s palm = 1% BSA
Count 2\textsuperscript{nd} and 3\textsuperscript{rd} degree only

Accurate calculation of %BSAB allows more accurate
Determination of fluid needs for resuscitation
<table>
<thead>
<tr>
<th>Area</th>
<th>0 to 1 Year</th>
<th>15 to 18 Years</th>
<th>Total</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>15%</td>
<td>9%</td>
<td>24%</td>
<td>14%</td>
</tr>
<tr>
<td>Neck</td>
<td>2%</td>
<td>2%</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Arm Torso</td>
<td>15%</td>
<td>6%</td>
<td>21%</td>
<td>13%</td>
</tr>
<tr>
<td>Arm Torso</td>
<td>15%</td>
<td>6%</td>
<td>21%</td>
<td>13%</td>
</tr>
<tr>
<td>Axilla</td>
<td>1%</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Upper arm</td>
<td>4%</td>
<td>4%</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>Upper arm</td>
<td>4%</td>
<td>4%</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>Lower arm</td>
<td>3%</td>
<td>3%</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>Lower arm</td>
<td>3%</td>
<td>3%</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>Thigh</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>Thigh</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>Leg</td>
<td>5%</td>
<td>4%</td>
<td>9%</td>
<td>5%</td>
</tr>
<tr>
<td>Leg</td>
<td>5%</td>
<td>4%</td>
<td>9%</td>
<td>5%</td>
</tr>
<tr>
<td>Foot</td>
<td>3%</td>
<td>2%</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>Foot</td>
<td>3%</td>
<td>2%</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>Total Area</td>
<td>24%</td>
<td>18%</td>
<td>42%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Surface Area ________ m^2

Weight ________ kg, Height ________ cm

History:

Photos:
- Yes
- No: Reason

RN Signature: ________ Date: ________ Time: ________
MD Signature: ________ Date: ________ Time: ________
Attending Signature: ________ Date: ________ Time: ________

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Severity of a burn injury depends on:

1. Depth of burn
2. TBSA involved
Lecture Overview

- Burn statistics and etiologies
- Pre-hospital evaluation
- Anatomy of a burn
- Transfer / treatment guidelines
ABA Guidelines for Admission to a Burn Center

- Any size third degree burn or second degree burn greater than 5% BSA
- Associated smoke inhalation
- Burns of the face, hands, feet, and genitalia
- Circumferential burns
- Burns that cross joints
- Chemical burns
- Electrical burns
- Suspected abuse
- Associated trauma (Friction burns)
- Associated chronic illness
- Older burn that failed outpatient treatment
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Initial Evaluation: Immediate Resuscitative Measures

Initial step as with every burn patient involves
• Stopping the burning process / extinguishing fire
• Removing burning clothes
• Cooling synthetic materials which retain heat with water
• Removing chemically contaminated clothes
• Covering burns with dry clean sheets

Next steps
• A airway
• B breathing
• C circulation
• D disability
• E exposure
Airway

Goal: Secure Airway

• Airway edema / inflammation
  – Direct thermal injury
    • Rapid onset
    • Rare below cords unless due to steam
  – Chemical and particulate injury
    • Tracheobronchial and parenchymal
      – Progressive stridor / hoarseness
      – Singed nasal hairs
      – Soot in oral cavity
      – Carbonaceous secretions
  – Cutaneous burns of face / neck
    • Slower progressive swelling
Airway

• Airway Management
  – Intubation by most experienced person
  – Nasal intubation preferred
    • Particularly facial involvement and large burns
    • Consider re-intubation by nasal route in presence of anesthesia
  – Secure using trach ties
  – Remember to maintain C-spine precautions

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Breathing

Goal: Adequate Oxygenation and Ventilation

- Provide 100% oxygen
- Consider CO poisoning
  - >15 CNS dysfunction
  - >40 obtundation / LOC

Children’s Hospital of Michigan
Breathing

• Circumferential chest burn
  – May need escharotomy

• Rib fractures / pneumothorax
  – May need chest tube

• Pediatric considerations
  – Chest wall is compliant
    • Restriction of circumferential burn
  – Rely on diaphragm
    • Decompress stomach
Circulation

Goal: Establish intravenous access and begin fluid administration

– Access is necessary if:
  • Burn >10%
  • Transport time > 60 minutes
  • Shock / hypotension
  • Need for IV medication
– Large bore peripheral IV’s
– LR, warm if available
– Continuous heart rate / blood pressure monitoring
Disability

Goal: Assess Brain

• Burn patient should be alert / oriented
  – If not:
    • Carbon monoxide poisoning
    • Traumatic brain injury
    • Hypoxemia
    • Hypovolemia

• Assess quickly using AVPU acronym
  A  alert
  V  responds to verbal stimuli
  P  responds to painful stimuli
  U  unresponsive
Exposure

Goal: Expose, Assess, and Protect

– Clothing removed except when adherent to burn
– Remove jewelry and constricting objects
– Evaluate for other signs of trauma
– Determine TBSA
– Cover patient in dry dressings / sheets
Resuscitation: The first 24hrs

• Fluid Resuscitation
  – Age 0-18 yrs (>15%)
  – Modified Parkland formula
    • 4mL x kg x %TBSA burn
    • Adjust to 6ml with inhalation injury
  – LR for all fluid
    • ½ volume given over 1st 8 hours from injury
    • ½ volume given over next 16 hours
  – <1 yr of age
    • Add D5LR at maintenance
  – Most add albumin after 8 hrs
Resuscitation: The first 24hrs

• Fluid Resuscitation
  – Document urine output hourly
    • 1mL/kg/hr for <30kg
    • 0.5mL/kg/hr for >30kg
  – Low urine output
    • 2 consecutive hours
      – Increase fluid rate by 15%
      – Repeat x 1 if output remains low
  – High urine output
    • 2 consecutive hours
      – >2mL/kg/hr for <30
      – >1mL/kg/hr for >30
    • Reduce fluid rate by 15%
      – After checking for glucosuria
Resuscitation: The first 24hrs

• Nursing Care
  – Height / Weight on admission
  – Stryker bed
    • With scale
  – Foley with temp probe
  – Central line care through burn skin
  – Room temp at 32 degrees C
    • Unless febrile
  – Circumferential burns
    • Doppler q1 hr x 24 hours
    • Doppler q4 hr x next 24 hours
  – Extension of neck and elevation of extremeties
  – Q2 turning
    • Avoid sliding due to shearing of dressings
Subsequent 24 hrs – 48 hrs

- Resuscitation phase should be concluding
- Fluid rates reduced to maintenance or near maintenance rate
- Enteral nutrition initiated if tolerated
- Operative plans made for excision and closure
Multidisciplinary Team

- Consults – All Admissions
  - Social work
  - Physical therapy
  - Occupational therapy
  - Nutrition
  - IR for PICC / NJ
  - Psychology
  - Ophtho
    - If facial burns involving eyes/peri orbital area
Surgical Management

• Operative choices
  – Debridement only
  – Excision and coverage
    • Temporary coverage with allograft
    • Definitive (immediate or delayed) coverage with autograft
      » Sheet
      » Meshed
      » Cultured
Pediatric Burn Management