Pediatric Trauma

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Objectives

• Describe unique anatomic and physiologic characteristics of children
• Define the concepts of primary and secondary surveys
• Discuss the identification and initial management of life-threatening injuries in the major organ systems: head and neck, chest, abdomen
Epidemiology

• Leading cause of death in children in North America
• 1.5 million injuries
• 250,000 hospitalizations
• 100,000 permanently disabled
Mechanism of Injury

- 87% blunt trauma
- Motor vehicle injuries and falls are the most common
- Vietnam
  - ~ 12,000 motor vehicle accidents per year
  - ~ 13,000 injuries
  - ~ 3,900 deaths
Children are Different

- Smaller body size
- Greater relative body surface area
- Internal organs are more anterior and protected by less subcutaneous fat
- Differences in the pediatric airway
- Cervical spine differences
- Head to toe body ratio greater
Children are Different

- Presence of physes- Salter-Harris fractures
- Greater distribution of force to a child resulting in multiple trauma
- Greater airway resistance and smaller more anterior airway makes airway management more difficult and the need for it more likely
Children are Different

• Greater head to body ratio making head injury more common
• Greater relative body surface area makes heat loss more clinically significant
Children are Different

• A child’s blood pressure may be maintained with up to 30% acute blood loss
  – Greater capacity to compensate by increasing heart rate and systemic vascular resistance
• Internal organs are more anterior making liver and spleen injuries more common
Approach to trauma management

• Organized approach and preparation
• Primary survey: assess life or limb threatening problems first
• Flow of care determined by A-B-C-D-E-F
• Team response
Primary Survey

- A: airway and cervical spine precautions
- B: breathing and treatment of life threatening chest injuries
- C: circulation with external hemorrhage control
- D: disability and neurologic screening
- E: exposure and thorough exam
  - Should be completed in 5 minutes
Airway

• Open airway using jaw thrust maneuver and maintain spinal precautions as needed
• Use suction to remove secretions, blood, and vomitus
Breathing

• Assess respiratory rate, effort and chest wall rise

• Assess adequacy of minute ventilation
  – Minute ventilation = tidal volume $\times$ resp rate
Breathing: Possible Interventions

- Supplemental oxygen
- Bag valve mask ventilation
- Endotracheal intubation
Indications for Endotracheal Intubation

- Inability to ventilate child by bag valve mask or need for prolonged airway management
- Respiratory failure
- Neurologic resuscitation
- Shock unresponsive to volume resuscitation
Recognize and Treat Any Life Threatening Chest Injuries

- Tension pneumothorax
- Cardiac tamponade
Circulation

• Recognize compensated shock
• Management priorities include stopping source of blood loss and restoration of circulating volume
Trauma Related Shock

- Hypovolemic – hemorrhage, burns
- Cardiogenic – myocardial contusion
- Obstructive – hemothorax or pneumothorax
- Distributive / Neurogenic – spinal cord injury
Circulation Assessment

• Heart rate
• Peripheral pulses
• Capillary refill time
• Blood pressure
• Precordial exam
• External bleeding
Signs of Shock

- Tachycardia
- Decreased mentation
- Abnormal skin findings
- Narrowed pulse pressure
- Decreased urine output
- Hypotension
Management of Shock

• Stop external bleeding
• Administer fluid resuscitation
  – Normal saline at 20 ml/kg repeat as needed
  – Packed RBCs at 10 ml/kg
• Surgery if condition remains unstable after fluid resuscitation
Intravenous access

- Peripheral IV
- Central line
- Intraosseus
- Venous cutdown
Laboratory Evaluation

• Priority: type and crossmatch
• Critical injury: complete cell count, electrolytes, renal function tests, glucose, prothrombin time (PT), partial thromboplastin time (PTT), type and crossmatch, urinalysis, amylase
• Minor injury: only as indicated, consider hemoglobin and urinalysis
Radiography

• Critical injury
  – chest radiography
  – Anterioposterior view of pelvis
  – CT of head and abdomen
  – Cervical spine series

• Minor injury
  – Only as indicated
Disability – Neurologic Screening

- Pupillary response
- Level of consciousness
- Glasgow Coma Score (GCS)
- Obvious localizing signs
- Assess neuro status before and after interventions
Glascow Coma Score

• Eye opening response
  – SPONTANOUS = 4
  – TO SPEECH = 3
  – TO PAIN = 2
  – NONE = 1
Glascow Coma Score

• Verbal
  – ORIENTED = 5
  – CONFUSED CONVERSATION = 4
  – INAPPROPRIATE WORDS = 3
  – INCOMPREHENSIBLE SOUNDS = 2
  – NONE = 1
Glasgow Coma Score

• Upper limb motor response
  – OBEYS COMMANDS = 6
  – VOCALIZES = 5
  – WITHDRAWS = 4
  – ABNORMAL FLEXION = 3
  – EXTENSOR RESPONSE = 2
  – NONE = 1
Suspect Cervical Injury

• Head, neck or face injury
  – Neck pain or neurologic symptoms at any time
  – Altered level of consciousness or presence of distraction on injury (fracture)
  – Mechanism of injury
Exposure

• A complete body check for signs of other injury
• Maintain modesty
• Maintain body temperature
• Look for signs of child abuse
Further Interventions

• Insert naso or orogastric tube
• Insert urinary catheter if needed after examination of rectum and perineum
Reassessment

• Secondary survey
  – History: A-M-P-L-E
  – Complete examination

• Additional radiographic and laboratory studies

• Problem identification
Family

• Family members often feel guilty regardless of actual involvement in injury
• Keep family informed
• Allow parent to be with child as much as possible
Psychosocial Issues for Pediatric Trauma Patients

• Fear of strange faces
• Separation anxiety
• Poor understanding of injuries
• Loss of function or to appear “different”
• Pain – *Please treat pain adequately*
Disposition

• Know local capability, resources and transfer policies
  – Critically injured children fare better in a pediatric ICU than in an adult ICU
  – Documentation and communication are vital to the continuity of care
Key Points to Remember

• Primary Survey A – B – C – D – E – F
• Assessments and interventions can happen simultaneously when working as a team
• Frequently reassess patient
• Obtain consultation early if available
• Keep family and patient informed
Burn Slides
Epidemiology

• Thermal burns are the 2nd most common cause of traumatic pediatric deaths in the USA
• Most occur in the home
• Scalding injuries most common in children under 3 years of age
Electric Injuries

• Electric burns account for ~5% of burn unit admissions
  – 1300 deaths
  – 5200 nonfatal injuries

• Pediatrics account for ~ 1/3 of these
## Classification: Depth

<table>
<thead>
<tr>
<th>Depth</th>
<th>Blisters?</th>
<th>Texture and color?</th>
<th>Pain?</th>
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</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; degree</td>
<td>Superficial</td>
<td>No blisters</td>
<td>Local erythema</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; degree</td>
<td>Partial thickness</td>
<td>Blisters</td>
<td>Mottled or red skin, moist</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; degree</td>
<td>Full thickness</td>
<td>No blisters</td>
<td>Pale, white or black skin, dry</td>
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</tbody>
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Classification: Extent

- Only partial and full thickness burns are included in calculations
- Rule of 9s
Classification

• For children under 9, use the Lund and Browder chart or estimate by assuming that a child’s palm = 1% of body surface area
Classification

- Major burn > 15-20% total body surface area
- Other important burns in children:
  - Face
  - Hands
  - Perineum
Initial Assessment and Management

- ABCs
Indicators of inhalation injuries

- Cyanosis
- Black sputum
- Oropharyngeal injury
- Hoarse voice cough
- Facial burns
- History of closed space confinement
- Decreased level of consciousness

*Intubate these patients early*
Initial Assessment and Management

• Vascular access and fluid resuscitation
  – Start for burns greater than 10% BSA
  – Use normal saline or lactated Ringers
  – 3 – 4 ml.kg body weight X % TBSA burned
    • Half over the first 4-8 hours and half over next 16-20 hours
    • Don’t forget maintenance fluid (dextrose) divided over 5 hours
Initial Assessment and Management

- Monitor urine output to maintain > 1 ml/kg/hr
- Complete blood count
- Electrolytes
- Renal function
- Urinalysis
- Administer tetanus prophylaxis and analgesia
- Consider nasogastric tube
Wound care

• Cool compresses only if < 10 %
• Wash with warm water or saline
• Debride only dead skin, leave blisters intact
• Apply antimicrobial agent (silver sulfadiazine)
Wound Care

- Cover with non-adherent dressing or leave open
- Escharotomy for constricting circumferential burns
- Reassess daily
Complications

- 1<sup>st</sup> hour: respiratory compromise
- Hours: burn shock
- Days: renal failure
- Days to weeks: infection, tetanus, iatrogenic
- Other: vascular compromise, ileus