WELCOME TO THE ER
You’d better hope you brought a book.
Rural Pediatric Trauma

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Objectives

- Scope of rural pediatric trauma
- The initial assessment of kids
  - Anatomical considerations and pitfalls
- FAST exam and imaging
- What do we need to do for transfer?
- Summary and Questions
Injuries remain leading cause of death in 1-19 year olds

- Each year, over 1 million ER visits for non-fatal injuries
  - 12,000 children die from unintentional injury

Costs are an extreme burden for acute care hospitals AND families

- Estimate cost of all injured patients in the US $671 Billion (2013)
- $22.4 Billion represents non-fataly injured kids between 0-14 years old
Access to pediatric trauma centers

**RURAL TRAUMA CARE IS VITAL FOR OUR KIDS!**

- 17.4 million children do not have access to pediatric trauma centers within 1 hour
- 90% of injured children do not have their first point of contact at a designated pediatric trauma center
  - As of 2018, only 109 ACS Designated Level I/II centers
- Most care lead by adult specialists with interest and variable training in pediatric specific trauma topics
When an injured trauma patient arrives...

- Be prepared!
  - Apply activation criteria that MAKES SENSE FOR YOU INSTITUTION
    - ACS COT has suggestions, MMC-Marshfield enthusiastic to be a local resource
  - COVID preparation (yuck!)
  - Pediatric specific “carts”
    - Airway equipment, Access equipment, Broselow/PAWPER tape
    - Pediatric signage
  - Pediatric specific protocols
    - Rapid Sequence Intubation, Fluid/Blood administration, I/O access
Primary Survey (ABCDE’s) – AIRWAY

- Most preventable deaths in children <14 due to airway complications
- Prominent occiput that tilts the head forward
- Short neck/Increased lymphoid tissue
- Floppy epiglottis

Simple upper airway maneuvers key

- Jaw thrust/Chin lift

Desaturations are rapid

- $O_2$ consumption from high metabolic rate
- Limited functional reserve capacity of lung
**AIRWAY TIPS**

- Oral intubation most common
  - Some evidence that VL has better visualization of glottis, but longer time to intubation and increased failure rates
- **DO WHAT YOU ARE BEST AT**
  - Most narrow portion of airway a cricoid membrane (not vocal cords)
  - Size of ETT: AGE/4 +3.5 (cuffed preferred)
  - 3 x diameter of tube = length to secure at lip
Airway pitfalls

Most common reasons for intubation difficulty:

1. Inappropriate sized ETT
2. Multiple failed attempts
3. Right mainstem intubation

Can cause intense laryngospasm and desaturations

USE Rapid sequence intubation
Pre-induction supplemental O2
Fentanyl/Lidocaine ok followed by sedative and rapidly acting muscle blockade

Rescue strategies

- Use a colorimetric device (EtCO₂ > 4%)
- Insert a LMA if unsuccessful

<table>
<thead>
<tr>
<th>Child weight</th>
<th>LMA size</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5 kg</td>
<td>#1</td>
</tr>
<tr>
<td>5-10 kg</td>
<td>#1.5</td>
</tr>
<tr>
<td>10-20 kg</td>
<td>#2</td>
</tr>
<tr>
<td>20-30 kg</td>
<td>#2.5</td>
</tr>
<tr>
<td>30-50 kg</td>
<td>#3</td>
</tr>
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</table>
Initial assessment

<table>
<thead>
<tr>
<th>Age</th>
<th>Respiratory Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 year</td>
<td>30-40</td>
</tr>
<tr>
<td>1-2 years</td>
<td>25-35</td>
</tr>
<tr>
<td>2-5 years</td>
<td>25-30</td>
</tr>
<tr>
<td>5-12 years</td>
<td>20-25</td>
</tr>
<tr>
<td>&gt;12 years</td>
<td>12-20</td>
</tr>
</tbody>
</table>

- Primary Survey (ABCDE’s) – **Breathing**
  - Children use diaphragm more due to underdeveloped chest wall musculature
  - Chest wall highly compliant with less ossified ribs
  - **Rib fractures suggest significant injury**
    - More likely to have TBI, HTX/PTX, and liver and spleen injuries
    - Very sensitive marker for trauma center need
  - Mediastinum very mobile
    - Concern for tension pneumothorax
Initial Assessment

- Primary Survey (ABCDE’s) – Circulation

- Not just the blood pressure
  - Level of consciousness, skin color, HR, peripheral pulses
  - BP can be falsely misleading

- Signs of decompensated shock
  - Altered mental status
  - Mottled skin with capillary refill >2 sec
  - Weak pulses

OK to call for transfer IMMEDIATELY!!!

<table>
<thead>
<tr>
<th>Age</th>
<th>Heart Rate beats/min</th>
<th>Systolic BP (mm Hg)</th>
<th>Diastolic BP (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 mo</td>
<td>100-150</td>
<td>65-85</td>
<td>45-55</td>
</tr>
<tr>
<td>3-6 mo</td>
<td>90-120</td>
<td>70-90</td>
<td>50-65</td>
</tr>
<tr>
<td>6-12 mo</td>
<td>80-120</td>
<td>80-100</td>
<td>55-65</td>
</tr>
<tr>
<td>1-3 yr</td>
<td>70-110</td>
<td>90-105</td>
<td>55-70</td>
</tr>
<tr>
<td>3-6 yr</td>
<td>65-110</td>
<td>95-110</td>
<td>60-75</td>
</tr>
<tr>
<td>6-12 yr</td>
<td>60-95</td>
<td>100-120</td>
<td>60-75</td>
</tr>
<tr>
<td>&gt; 12 yr</td>
<td>55-85</td>
<td>110-135</td>
<td>65-85</td>
</tr>
</tbody>
</table>

Circulation Pitfalls

- IV Access can be challenging
  - Smaller veins and more subcutaneous fat
  - Vein collapse from hypovolemia, hypothermia, hematomas and fractures
  - First attempt in AC, then saphenous vein at ankle, Interosseous catheter placement (after 3 tries) in proximal tibia, proximal humerus, or distal femur

- 20mL/kg bolus of LR or 0.9%NS
  - Repeat once then proceed with blood
Disability

- Assessment of level of consciousness, pupillary exam, and neurological exam
- Pediatric Glasgow Coma Scale
  - Have it on the wall!
- Serious brain injury
  - Unilateral pupil dilatation suggests impending hemiation
  - Intubation followed by brief hyperventilation (ETCO₂ of 30)
  - Administer 3% hypertonic saline at (1-5mL/kg)
  - Avoid mannitol unless certain isolated head injury

<table>
<thead>
<tr>
<th>PEDIATRIC GLASGOW COMA SCALE (PGCS)</th>
<th>&gt; 1 Year</th>
<th>&lt; 1 Year</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EYE OPENING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spontaneously</td>
<td>Spontaneously</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>To verbal command</td>
<td>To shout</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>To pain</td>
<td>To pain</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>No response</td>
<td>No response</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>MOTOR RESPONSE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obeys</td>
<td>Spontaneous</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Localizes pain</td>
<td>Localizes pain</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Flexion-withdrawal</td>
<td>Flexion-withdrawal</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Flexion-abnormal (decorticate rigidity)</td>
<td>Flexion-abnormal (decorticate rigidity)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Extension (decerebrate rigidity)</td>
<td>Extension (decerebrate rigidity)</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>No response</td>
<td>No response</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>VERBAL RESPONSE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oriented</td>
<td>Appropriate words/phrases</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Disoriented/confused</td>
<td>Inappropriate words</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>Persistent cries and screams</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
<td>Grunts</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>No response</td>
<td>No response</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

TOTAL PEDIATRIC GLASGOW COMA SCORE (± 15):
Exposure

- Children are more susceptible to hypothermia
  - Can lead to arrhythmias, coagulopathy, and persistent acidosis
  - 9.2 X more likely to die if arrive cold on transport
- Set trauma room temperature to 80 degrees
- Remove all wet cloths (including partially cut off)
- Use warmed IVF, Bair hugger when temperature is below 36 degrees C
Initial Labs/Imaging

- **IMAGING IS NOT REQUIRED FOR TRANSFER, DO NOT DELAY FOR IMAGES!!!**
- Order labs and images only if it will directly influence your management
  - CXR in all cases
  - Pelvic fracture uncommon in children, obtain only with concerning signs or physical exam (unexplained hypotension, pelvic instability, blood at penile meatus or urethra)
  - NO routine lab tests have good sensitivity, specificity, PPV or NPV alone!
    - MMC-M T&S only, +/- CBC for level 2 activations,
    - Highest level activations test for metabolic state (ABG), blood loss (CBC) and coagulopathy (TEG)
Image Gently Campaign

- Half of all radiation attributable to medical imaging
- Pediatric patients account for only 4% of all CT imaging, but 20% of all CT-related cancer deaths
  - Linear relationship between development of leukemia and chest/brain cancer
  - Estimated that between 1 in 570 to 1 in 6130 CT scans will lead to childhood cancer depending on age, sex, and type of study
- ONLY order the test if it will influence your center's care of the patient
- Regional Trauma Advisory Council (RTAC) has a position statement out supporting this for northern Wisconsin
- “The 5 things that physicians should question” is the routine use of whole body diagnostic CT scanning
Focused Assessment with Sonography for Trauma (FAST)

- Is an adjunct to the primary survey in many centers, depending on availability and user training.
- Due to poor sensitivity, FAST should not be used to Rule Out injury.
  - 30-50% of negative FAST exams have solid organ injury in children with concerning exam findings.
- Abdominal tenderness has a 6X increase risk of significant abdominal trauma.
  - Other important findings are bruising/seatbelt sign, cyanosis.
Summary

- Trauma remains the #1 cause of death for children ages 1-19
  - Most children do not have access to dedicated trauma centers and are initially treated by adults practitioners with an interest in pediatrics – THANK YOU!

- Be prepared – Have signage of important protocols, drug dosages, and data

- Airway issues are the #1 cause of preventable deaths
  - Due to anatomic features of a child’s head and neck
  - Chose the correct size: age/4 + 3.5 or size of pinky finger
  - Tape at the correct distance: Tube size X3 = distance to insert tube at lip
  - Use a LMA for rescue
Summary Cont...

Access can be challenging
- Start with antecubital fossa, hand, and then saphenous
- Failed attempts X 3, move to I/O access

Resuscitation
- Start with LR bolus 20mL/kg X2
- Move to blood early and during transport if able
- FAST exam cannot exclude intra-abdominal source of blood loss

Imaging
- CXR in nearly all cases
- Order only tests that will impact YOUR management
- Never delay transport for imaging
QUESTIONS?