Pediatric Thoracic Trauma

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Kings County Hospital
7/14/2011
Case Presentation
History

- 3 year old girl pedestrian struck. The child ran out of the laundry mat and hit by a car. Mother did not witness the event but found the child awake, alert, crying, and responsive.

- PMH/PSH: eczema

- Birth hx: unremarkable

- Medications: none

- Allergies: NKDA
Physical Exam

- T 98.8 BP 109/61 HR 147 Sat 98% Wt 15kg
- GCS 11
- HEENT: forehead laceration and left eyebrow laceration, pupils equal and reactive, c-collar intact
- Chest: equal chest rise, BS bilaterally, diminished L>R
- Cardio: regular rhythm
- Abdomen: soft, nondistended
- Ext: gross deformity of the left thigh, pulse palp
- DRE: normal tone
# Labs

<table>
<thead>
<tr>
<th>10</th>
<th>12</th>
<th>445</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>141</td>
<td>151</td>
</tr>
<tr>
<td></td>
<td>108</td>
<td></td>
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<tr>
<td></td>
<td>19</td>
<td></td>
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<tr>
<td></td>
<td>0.68</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>319</td>
<td>241</td>
</tr>
<tr>
<td>4.3</td>
<td>147</td>
<td>0.2</td>
</tr>
<tr>
<td>13</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
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</tr>
</tbody>
</table>
In the ED, patient was noted to be more lethargic.

Reassessed, GCS 8, vitals unchanged.

Intubated.

Imaging studies

- Head CT
- Cervical Spine CT
- Chest CT
- Abd/pelvis CT
Hospital Course

- HD#2
  - Hct 24, transfused prbc 10cc/kg x 2
  - AST/ALT trending down
  - ABG 7.30/39/122/19/-5.9 on PEEP 5, FiO2 35%
- HD#3-4 – ventilator support
- HD#5 – extubated
- HD#7 – closed reduction of femur fx and placement of hip spica cast by ortho.
  Transferred to floor from PICU.
- HD#8 – discharged home
Pediatric Thoracic Trauma

- Epidemiology
- Assessment
  - A-B-C's
  - Anatomic and physiologic differences
- Thoracic Injuries
  - Rib Fractures
  - Pulmonary contusions
  - Pneumothorax/hemothorax
  - Traumatic pseudocysts
Trauma is the leading cause of death in the pediatric population
Epidemiology

- Thoracic injuries is the second leading cause of death in pediatric trauma following head injuries.
- 3x more common in males than females.
- Primarily due to blunt trauma (85%):
  - Motor vehicle collisions (passenger/pedestrians)
  - Falls
  - Child abuse
  - Sports injuries (adolescents)
Most common thoracic injuries
  - Pulmonary contusion
  - Pneumothorax
  - Hemothorax
  - Rib fractures

60-85% of thoracic injuries have other significant injuries

Overall mortality from thoracic trauma is 15 – 25%
  - Isolated thoracic trauma – 5%
  - Thoracic and head or abdominal trauma – 28-37%
  - Thoracic, head and abdominal trauma – 40%
Children are NOT the same as adults!
Airway

- Large head and short neck – neck passively flexed
- Large tongue - upper airway obstruction
- Narrowest point at subglottis
  - ET tube size – size of 5th digit
- Short trachea – right main stem intubation
- Surgical airways
  - Surgical cricothyrotomy not recommended <10yo
  - Prefer needle cricothyrotomy

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Breathing

- Smaller chest transmit breath sounds more readily – large ptx can be present with what sounds like equal breath sounds
- Chest wall is more compliant = increase work of breathing
- High basal metabolic rate = rapid oxygen consumption = hypoxia
- Functional residual capacity is smaller in proportion to total lung volume – less reserve to preoxygenate with 100% O2 = rapid desaturation during intubation
Blood pressure is not a reliable assessment.

Rate, quality of peripheral pulse, skin color/temp, capillary refill are better indicators of adequate perfusion.

### Table 5 Normal Vital Signs by Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Weight (kg)</th>
<th>Heart rate (beats/min)</th>
<th>Pressure a (mmHg)</th>
<th>Respiration (breaths/min)</th>
<th>Urine output (mL/kg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6 months</td>
<td>3–6</td>
<td>160–180</td>
<td>60–80</td>
<td>60</td>
<td>2</td>
</tr>
<tr>
<td>Infant</td>
<td>12</td>
<td>160</td>
<td>80</td>
<td>40</td>
<td>1.5</td>
</tr>
<tr>
<td>Preschool</td>
<td>16</td>
<td>120</td>
<td>90</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>Adolescent</td>
<td>35</td>
<td>100</td>
<td>100</td>
<td>20</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*aSystolic blood pressure should be 80 + 2 age (yrs).

Source: Taken from Advanced Trauma Life Support® for Doctors Instructor Manual.
Circulation

- Normal blood volume = 70-80ml/kg
- What appears to be a small amount of blood can be significant blood loss in child
- Compensate up to 40% blood loss
- Access: intravenous, intraosseous, saphenous cut-down
- Resuscitation
  - 20ml/kg Lactated Ringers/Normal saline bolus
  - 10ml/kg prbc
Rib Fractures

- Uncommon in younger children
- Thoracic cage is more compliant
  - Increase cartilage content
  - Incomplete ossification of ribs
- Significant injuries can be present WITHOUT rib fractures – Increase compliance allows greater transmission of kinetic energy to the underlying lung parenchyma
- Presence of rib fractures is a marker of severity of injury
  - Mortality rate 42% vs 2% comparing children with and without rib fractures
Pattern and presentation of blunt chest trauma among different age groups.
Moataz Hanafi, Nael Al-Sarraf, Hazem Sharaf, Atef Abdelaziz.
Asian Cardiovascular and Thoracic Annals 2011; 19:48-51

<table>
<thead>
<tr>
<th>Isolated chest Injury</th>
<th>Pediatric</th>
<th>Adult</th>
<th>Elderly</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>30 (65%)</td>
<td>260 (68%)</td>
<td>45 (82%)</td>
<td></td>
</tr>
<tr>
<td>Rib fractures only</td>
<td>7 (15%)</td>
<td>132 (34%)</td>
<td>5 (9%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Rib fractures with hemothorax/pneumothorax/hemopneumothorax</td>
<td>23 (50%)</td>
<td>72 (19%)</td>
<td>40 (72%)</td>
<td>0.03</td>
</tr>
<tr>
<td>Bilateral rib fractures + emphysema requiring bilateral chest tubes</td>
<td>0</td>
<td>56 (15%)</td>
<td>0</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Parenchymal lung injury</td>
<td>0</td>
<td>30 (8%)</td>
<td>2 (4%)</td>
<td>0.01</td>
</tr>
<tr>
<td>Lung contusion</td>
<td>2 (4%)</td>
<td>40 (10%)</td>
<td>3 (5%)</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>
Pulmonary Contusion

- More common in children and will often present without rib fractures
- Appear as irregular infiltrates in nonanatomic distribution
- Decrease lung compliance and ventilation/perfusion mismatch leads to hypoxia
- Treatment: supportive – analgesia, supplemental oxygen, mechanical ventilation
Pneumothorax/Hemothorax

- **Pneumothorax**
  - Breath sounds may sound equal, sound easily transmitted from contralateral side
  - Observation of asymmetric chest rise
  - Tension pneumothorax – high risk of cardiopulmonary collapse due to mobile mediastinum

- **Hemothorax**
  - Commonly from penetrating trauma, rib fractures, high speed collision
  - Indication for thoracotomy
    - Initial drainage >15-20ml/kg
    - Ongoing drainage >3ml/kg/hr
Traumatic Pneumatocele/Pseudocyst

- Cavitary lesions without an epithelial lining that develop in lung parenchyma after blunt trauma
- Rare finding, 3-4% of thoracic trauma
- Occurs in children and young adult
- Rapid compression/decompression causes lung parenchymal lacerations resulting in thin-walled cavity lesions filled with air and fluid
- Associated with pulmonary contusion, hemothorax, pneumothorax, rib fracture
- Symptoms: hemoptysis, cough, chest pain, dyspnea
- Dx: clinical history of trauma and CXR/CT scan
- Course is usually self-limited, resolves spontaneously weeks-months
- Treatment is conservation management unless complicated by infection, bleeding, increasing size
Table 1: The general characteristics of the TPP cases reported in the last 10 years.

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Age</th>
<th>Sex</th>
<th>Etiology</th>
<th>Hemo and/or pneumothorax</th>
<th>Treatment of TPP</th>
<th>Resolution time of TPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stathopoulos et al (2002)</td>
<td>1</td>
<td>16</td>
<td>Male</td>
<td>Motorcycle accident</td>
<td>1</td>
<td>Conservative</td>
<td>2 months</td>
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<tr>
<td>Watanabe et al (2005)</td>
<td>1</td>
<td>34</td>
<td>Male</td>
<td>Sport injury</td>
<td>1</td>
<td>Conservative</td>
<td>43 days</td>
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<tr>
<td>Crausman RS (2006)</td>
<td>1</td>
<td>38</td>
<td>Male</td>
<td>Industrial machinery</td>
<td>-</td>
<td>Conservative</td>
<td>?</td>
</tr>
<tr>
<td>Celik B and Basoglu A (2006)</td>
<td>1</td>
<td>28</td>
<td>Male</td>
<td>Motorcycle accident</td>
<td>1</td>
<td>Conservative</td>
<td>?</td>
</tr>
<tr>
<td>Chon et al (2006)</td>
<td>12</td>
<td>17.7 (2–48)</td>
<td>Male 11</td>
<td>Traffic accident 9 Fall down 2 Battery 1</td>
<td>11</td>
<td>Conservative</td>
<td>85.6 days</td>
</tr>
<tr>
<td>De et al (2007)</td>
<td>1</td>
<td>19</td>
<td>Male</td>
<td>Traffic accident</td>
<td>1</td>
<td>Conservative</td>
<td>?</td>
</tr>
<tr>
<td>Cai MH and Lee WJ (2007)</td>
<td>1</td>
<td>26</td>
<td>Male</td>
<td>Motorcycle accident</td>
<td>1</td>
<td>Conservative</td>
<td>?</td>
</tr>
</tbody>
</table>
References
