CT Chest in the Evaluation of Pediatric Thoracic Trauma

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No Disclosures.
Pediatric Thoracic Trauma

- Thoracic trauma 2\textsuperscript{nd} most common cause of trauma-related death
  - Associated with 15-25% mortality
- >80% pediatric thoracic trauma secondary to blunt forces
  - High energy impact
  - Multiple regions of body
Lack of Consensus Guidelines in Initial Evaluation
Pediatric Injuries Difficult to Diagnose

• Unable to cooperate with exam
• More compliant chest wall
  – High energy impact
  – Severe injury without fracture
• Major life threatening chest trauma rare
  – 0.1% incidence of thoracic aortic injury
  – 85% die at the scene
• CT Scan – accurate and rapid diagnosis of intra-thoracic injury
  – Overused in pediatric population
Admission CXR as a screening tool

<table>
<thead>
<tr>
<th></th>
<th>Chest Xray</th>
<th>CT Chest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevant Organ Radiation Dose&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.01mSv</td>
<td>2-20mSv</td>
</tr>
<tr>
<td>Cost&lt;sup&gt;2&lt;/sup&gt; (CMS fees)</td>
<td>$25</td>
<td>$275</td>
</tr>
</tbody>
</table>

- Identification of majority of major thoracic injuries
- Determine who would benefit from a CT Chest

<sup>1</sup>Brenner and Hall, N Engl J Med 2007
<sup>2</sup>CMS.gov Physician Fee Schedule
Hypothesis

Limiting CT Chest to patients with a widened mediastinum identifies patients with intra-thoracic vascular injuries not otherwise seen on CXR.

All other injuries requiring a change in management are visible on CXR.
Methods

• All pediatric blunt trauma activations (2005-2013)
  – Level 1 pediatric trauma center
  – Admission CXR

• Radiologic findings

• Outcomes
  – Missed injuries on CXR, change in patient management after CT scan, chest tube, operation for intra-thoracic injury
All Blunt Trauma Activations (2005-2013) <19yo, CXR on Admission
N=1035

Methods

CXR only
N=896

- Normal CXR
  N=714
- Abnormal CXR
  N=182

CXR and CT chest
N=139

- Normal CXR
  N=71
- Abnormal CXR
  N=68

97% Panscan
Demographics and Mechanism

- Average age 7.1 +/- 4.7 years
- 64% Male
- 36% Female
CT chest decreases normal studies

* * * p<0.05

Number of Patients

- Normal
- Contusion/Atelectasis
- Pneumothorax
- Hemothorax/effusion
- Rib Fracture(s)
- Other Fracture
- Mediastinal Abnormality
- Vascular Injury

Legend:
- CXR
- CT Chest
Added diagnoses on CT Chest

* 42%
Pneumo/Hemothorax (N=50)
CXR (N=25), CT Chest only (N=25)

- Chest Tube
  - No CT Chest
    - N = 5

- Chest tube
  - After CT Chest
    - N = 6

- No Chest tube
  - N = 39

- Enlarging ptx on repeat CXR
  - N=3

- Seen on CXR and CT
  - N=2

- On CT alone prior to exlap
  - N=1
## Mediastinal abnormalities on CT Scan

<table>
<thead>
<tr>
<th>CT Chest Finding</th>
<th>CXR Finding</th>
<th>Added N</th>
<th>Change in Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumomediastinum (6)</td>
<td>Pneumomediastinum (4) Contusions (2)</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>Mediastinal Hematoma (2)</td>
<td>Abn mediastinum (1) Contusions (1)</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>Pericardial Effusion (1)</td>
<td>Contusions</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>Esophageal Injury (1)</td>
<td>Clavicle fx</td>
<td>1</td>
<td>Esophagram → No injury</td>
</tr>
<tr>
<td>Aortic Injury (2)</td>
<td>Widened mediastinum</td>
<td>0</td>
<td>1 CTA → no injury</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 thoracotomy, interposition graft</td>
</tr>
</tbody>
</table>
CXR is an adequate screening tool

• No missed injuries patients with CXR only
• CT Chest changed management in only 2.9% of patients
  – No change in management after normal CXR
• Use of CT chest for widened mediastinum on CXR only
  – 27 patients, 1 thoracic aortic injury
  – 80% fewer CT Chest
Conclusion

• CT Chest is overused in pediatric trauma
  – Increased cost and radiation exposure
  – Adds diagnoses but rarely changes management
• Most injuries are identified on CXR
  – Can be managed clinically or followed with CXR
• Use of CT Chest should be limited to patients with widened mediastinum
  – For identification of vascular injuries not visible on CXR
Thank you

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Jeffrey Upperman, MD
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Jordan Bowling, MD
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Rita Burke, PhD MPH
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