Point of Care Ultrasound versus Chest X-ray in Detection of Pneumothorax Prior to Removal of Tube Thoracostomy in Trauma Patients

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Ultrasound

• Well-validated for ruling out pneumothorax (PTX)
  – Lung sliding and comet tails

• Compared to chest X-Ray (CXR) for detection of traumatic PTX
  – More sensitive
  – More specific
  – Less expensive
  – Faster
Clinically significant PTX (CS-PTX):

- CXR: >10% per attending radiologist
- Ultrasound: loss of comet tails and/or sliding sign at >1 intercostal space (ICS)

Prospective non-inferiority study

**Inclusion criteria:**
- Trauma patients with tube thoracostomy (TT)

**Exclusion criteria:**
- Severe subcutaneous emphysema
- Adhesions of pleura
- Thoracic skin injuries
- Restrictive lung diseases
- Painful skin lesions
- Painful fractures

**Methods**

POCUS prior to CXR to assess for residual PTX when:
- TT to water seal for 12-24 hr
- < 200mL drained over 12-24 hr

POCUS operators were POCUS trained family medicine residents:
- 30min focused lung ultrasound training and
- At least 10 proctored lung US exams (including 5 positive for PTX)

Blinded to CXR, POCUS operator made binary decisions

Final management decided by trauma team based on CXR
### Results

**Clinically significant PTX (CS-PTX):**
- **CXR:** >10% per attending radiologist
- **Ultrasound:** loss of comet tails and/or sliding sign at >1 intercostal space (ICS)

<table>
<thead>
<tr>
<th>Subjects w/confirmed rib Fx</th>
<th>Avg POCUS time</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>4min</td>
</tr>
</tbody>
</table>

- **7 No CS-PTX seen on CXR were missed on POCUS:**
- **10 non CS-PTX were seen on CXR but not seen on POCUS:**
- **16 CS-PTX seen on POCUS were not seen on CXR:**
- **1 pre-removal exam was POCUS positive and CXR negative:**

### Table 1

<table>
<thead>
<tr>
<th>Total Subjects</th>
<th>Total Studies</th>
<th>Avg BMI</th>
<th>Subjects w/confirmed rib Fx</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>62</td>
<td>26</td>
<td>29</td>
</tr>
</tbody>
</table>

### Table 2

<table>
<thead>
<tr>
<th>Total PTX</th>
<th>CXR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTX</td>
<td>No</td>
</tr>
<tr>
<td>19</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No PTX</th>
<th>CXR</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3: Pre-removal exam for Subsequent CS-PTX Reaccumulations

<table>
<thead>
<tr>
<th>POCUS</th>
<th>CXR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-PTX</td>
<td>CS-PTX: 1, No CS-PTX: 3</td>
</tr>
<tr>
<td>No CS-PTX</td>
<td>CS-PTX: 0, No CS-PTX: 3</td>
</tr>
</tbody>
</table>

### Table 3: Pre-removal exam when all PTX Reaccumulation Occurred

<table>
<thead>
<tr>
<th>POCUS</th>
<th>CXR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTX</td>
<td>PTX: 1, No PTX: 4</td>
</tr>
<tr>
<td>No PTX</td>
<td>No PTX: 0, 12</td>
</tr>
</tbody>
</table>
Conclusions

• No CS-PTX seen on CXR were missed by POCUS
• POCUS is non-inferior to CXR in detecting CS-PTX prior to the removal of TT in simple (ie: single TT) trauma patients
• A POCUS-based algorithm assessing for PTX prior to removal of TT deserves further considerations
Proposed algorithm for future research

<200mL discharge
&
Water seal for >6 hours
References


END