Point-of-Care Lung Ultrasound to Diagnose the Etiology of Acute Respiratory Failure in the PICU

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**METHODS**

- **BACKGROUND**
  - Point-of-care lung ultrasound (POC-LUS) is used as an alternative to chest radiograph in the initial assessment of adults with acute respiratory failure (ARF) because of significantly higher diagnostic accuracy.
  - Pediatric POC-LUS has a growing body of research supporting its use, yet it remains an understudied tool in the PICU.
  - Study objective: determine the sensitivity and specificity of POC-LUS in identifying the etiology of ARF on admission to the PICU.
  - Study hypothesis: POC-LUS would have a sensitivity and specificity of >90% in identifying the etiology of ARF.

- **EXCLUSION CRITERIA**
  - Known chronic respiratory disease, non-English speaking family/guardian
  - Age >37 weeks and <19 years of age
  - Not on qualifying support, n=92
  - Chronic respiratory disease, n=17
  - Non-English speaking, n=14
  - Age ≥18 weeks and ≤19 years, n=6

- **INCLUDED CRITERIA**
  - Approached & consent not granted, n=16
  - Not allowed by PICU provider, n=2
  - Removed for multiple final diagnoses, n=1
  - Enrolled in study, n=88
  - Analyzed in study, n=87

**RESULTS**

- 88 patients were enrolled and participated in the study (Figure 1). - 10 patients had a final diagnosis of status asthmaticus (11%), 48 had bronchiolitis/viral pneumonitis (55%), 29 had pneumonia (33%), and 1 was excluded from analysis because of an inability to differentiate the final diagnosis.
- POC-LUS correctly identified the etiology of acute respiratory failure in 54% of patients; sensitivity and specificity of the POC-LUS compared to the final diagnosis is in table 1 and kappa statistics in table 2.

**Table 1. Sensitivity and specificity of POC-LUS diagnosis compared to final diagnosis**

<table>
<thead>
<tr>
<th>Final Diagnosis</th>
<th>Status Asthmaticus</th>
<th>Bronchiolitis</th>
<th>Pneumonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Asthmaticus, n=10</td>
<td>0.70 (95% CI 0.40–0.89)</td>
<td>0.46 (95% CI 0.33–0.60)</td>
<td>0.62 (95% CI 0.44–0.77)</td>
</tr>
<tr>
<td>Bronchiolitis, n=48</td>
<td>0.82 (95% CI 0.72–0.89)</td>
<td>0.72 (95% CI 0.56–0.83)</td>
<td>0.74 (95% CI 0.62–0.84)</td>
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<tr>
<td>Pneumonia, n=29</td>
<td>0.80 (95% CI 0.72–0.89)</td>
<td>0.72 (95% CI 0.56–0.83)</td>
<td>0.74 (95% CI 0.62–0.84)</td>
</tr>
</tbody>
</table>

**DISCUSSION**

- Lichtenstein initially demonstrated >80% sensitivity and >90% specificity of POC-LUS to differentiate the etiology of adult ARF on admission to the medical ICU.
- Numerous researchers have substantiated these findings; however, adults have different etiologies of ARF (COPD exacerbation, pneumonia, acute congestive heart failure, and ARDS) compared to children (status asthmaticus, pneumonia, and bronchiolitis).
- One prior study has examined POC-LUS in PICU patients showing moderate sensitivity (63.4%) using a non-blinded study protocol (no specificity reported).

- Determining the optimal role of POC-LUS demonstrates moderate to low sensitivity and specificity in identifying the etiology of pediatric acute respiratory failure on admission to the PICU.

- Etiology of Acute Respiratory Failure in the PICU: LUS correctly identified the etiology of acute respiratory failure in 54% of patients; sensitivity and specificity of the POC-LUS in identifying the pulmonary etiology of ARF, n=270.

**Table 2. POC-LUS demonstrates fair agreement with final diagnosis, k=0.28 (95% CI 0.11–0.43), kmax=0.73, k/kmax=0.38 (95% CI 0.16–0.61).**