Resolution of Clinical Signs of Ventilator-Associated Pneumonia in Trauma Patients

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Resolution of Clinical Signs of Ventilator-Associated Pneumonia in Trauma Patients

Abstract
Objectives: The ATS/IDSA Ventilator-Associated Pneumonia (VAP) guidelines suggest that clinical improvement of VAP should be apparent within 3–6 days. This study evaluated resolution of clinical signs of VAP in trauma patients after diagnosis.

Methods: Critically injured adults admitted to the trauma intensive care unit (ICU) from June 1, 2006, to December 31, 2007, and subsequently given a diagnosis of VAP were retrospectively assessed. Clinical signs, including derangements of maximum temperature (Tmax), white blood cell (WBC) count, and PaO2/FiO2, were evaluated on days 1–16 after VAP diagnosis. Data are presented as mean ± SD unless otherwise stated. Clinical parameters after VAP were compared using repeated-measures ANOVA with the Tukey test for multiple comparisons.

Results: A total of 82 patients were identified. Data for the 34 patients without concurrent infections are presented. Demographic data include: Age 46 ± 17 years; 71% men; 94% blunt trauma; median (IQR) Injury Severity Score 29.5 (24–38); duration of mechanical ventilation 33 ± 27 days; ICU length of stay (LOS) 39 ± 25 days; hospital LOS 53 ± 33 days. Clinical signs following VAP diagnosis: Tmax (°F): Day 1=101.8 ± 1.3, Day 3=101.1 ± 1.1, Day 6=101.1 ± 1.4, Day 16=100.1 ± 3. Compared to Day 1, there was a significant reduction in Tmax at days 10, 11, 12, 13, 14, and 16 (p<0.05 for all). WBC count (cells per microliter): day 1 = 12.9 ± 5, day 3 = 13.7 ± 5, day 6 = 14.4 ± 5, and day 16 = 13.8 ± 6. There was no significant difference in WBC on days 1–16 (p=0.42). PaO2/FiO2: day 1 = 232 ± 108, day 3 = 200 ± 87, day 6 = 218 ± 104, day 16 = 246 ± 126. Differences in PaO2/FiO2 on days 1–16 did not reach statistical significance (p=0.06).

Conclusion: Improvement of clinical parameters after a VAP diagnosis is delayed in trauma patients. Alternative methods for determining resolution should be investigated. Published in To be published in Critical Care Medicine’s December 2009 supplement.

Disciplines
Pharmacy and Pharmaceutical Sciences

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RESOLUTION OF CLINICAL SIGNS OF VENTILATOR-ASSOCIATED PNEUMONIA IN TRAUMA PATIENTS

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G. Christopher Wood, Pharm.D., FCCP, BCPS

ACCP Spring Meeting; April 2010; Charlotte, NC

VENTILATOR-ASSOCIATED PNEUMONIA (VAP)

• Most frequent ICU-acquired infection among mechanically ventilated patients
• ↑ morbidity
• ↑ costs
  – ~ $40,000 per patient
• ~30-70% mortality

Am J Respir Crit Care Med. 2006; 388-416

VAP GUIDELINES

• Clinical parameters used to define normal pattern of resolution
  – White blood cell (WBC) count
    – Normal – 5 to 10 cells/μL
  – Temperature
    – Normal – 98.6° F
  – PaO2:FiO2
    – Normal – 380 to 475
• Clinical improvement: 48-72 hours
• Recommended therapy: 7-14 days

Am J Respir Crit Care Med. 2006; 388-416

CHARACTERIZATION OF VAP RESOLUTION IN MIXED ICU

• Describe clinical response
  – Patients with VAP
  – Receiving appropriate antimicrobial therapy
• 27 patients with VAP
• Described changes over time:
  – Temperature
  – WBC
  – PaO2:FiO2

Am J Respir Crit Care Med. 2001;163:1375

MAXIMUM TEMPERATURE OVER TIME

WBC COUNT OVER TIME

Am J Respir Crit Care Med. 2001;163:1375
PaO2/FiO2 OVER TIME

Dennesen et al

- Mean (median) duration of resolution
  - Temperature – 5 (3) days
  - WBC – 8 (6) days
  - PaO2/FiO2 – 6 (2) days
  - Combined – 6 (6) days
- Conclusions
  - Clinical response to therapy for VAP occurs w/in first 6 days of therapy

DIFFERENCES IN TRAUMA PATIENTS

- VAP incidence 2-3x greater than other populations
- 90% systemic inflammatory response syndrome (SIRS) in 1st week
  - Same parameters
    - VAP response
    - SIRS

CURRENT STUDY PURPOSE

- Specific Aim
  - To describe resolution of clinical signs of VAP in trauma pts
- Hypothesis
  - Trauma pts have delayed resolution of clinical signs of VAP

METHODOLOGY

- Design
  - Retrospective review from pre-existing database
    - January 1, 2007 through December 31, 2007
- Inclusion
  - Critically injured trauma pts diagnosed with VAP
    - All pts diagnosed using unit-specific clinical pathway
- Exclusion
  - Age <18 years
  - Pregnant
  - Immunocompromised state
    - Corticosteroids, chemotherapy, malignancy

VAP Pathway

Clinical Suspicion of VAP

- CXR
- Temperature
- WBC
- Purulent sputum

Fiberoptic Bronchoscopy with BAL

- NGTD/ <100,000 cfu/mL
  - Discontinue antibiotic therapy
- ≥100,000 cfu/mL
  - Expand coverage if organisms not covered

- Ampicillin/sulbactam 3g IV q6h
- Vancomycin 20mg/kg IV q12h
- Cefepime 2g IV q8h

Preliminary culture results >24 hours

- <7 days in ICU
- >7 days in ICU

- Discontinue antibiotic therapy
- Expand coverage if organisms not covered
METHODOLOGY

• Clinical Endpoints
  – Improvement or resolution
  – Temperature
  – WBC count
  – PaO₂: FiO₂
• Statistical analysis
  – Descriptive Statistics
  – ANOVA
  • Tukey Test for multiple comparisons

PATIENT DEMOGRAPHICS

All Patients (n = 82)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (mean ± SD)</td>
<td>44 ± 17</td>
</tr>
<tr>
<td>Males, number (%)</td>
<td>60/23 (72)</td>
</tr>
<tr>
<td>Blunt Injury %</td>
<td>86</td>
</tr>
<tr>
<td>Injury Severity Score, median (IQR)</td>
<td>34 (25 to 42)</td>
</tr>
<tr>
<td>Duration of mechanical ventilation, days (mean ± SD)</td>
<td>32 ± 32</td>
</tr>
<tr>
<td>ICU LOS, days (mean ± SD)</td>
<td>37 ± 31</td>
</tr>
<tr>
<td>Hospital LOS, days (mean ± SD)</td>
<td>51 ± 38</td>
</tr>
<tr>
<td>Mortality, %</td>
<td>16/67 (19)</td>
</tr>
</tbody>
</table>

PATIENT DEMOGRAPHICS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
<th>Patients without Concurrent Infections (n = 34)</th>
<th>Patients with Concurrent Infections (n = 48)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (mean ± SD)</td>
<td>46 ± 17</td>
<td>43 ± 17</td>
<td>41 ± 17</td>
<td>0.39</td>
</tr>
<tr>
<td>Males, number (%)</td>
<td>24/10 (71)</td>
<td>36/13 (73)</td>
<td>40/11 (86)</td>
<td>0.97</td>
</tr>
<tr>
<td>Blunt Injury %</td>
<td>32/2 (94)</td>
<td>39/10 (86)</td>
<td>34/10 (87)</td>
<td>0.11</td>
</tr>
<tr>
<td>Injury Severity Score, median (IQR)</td>
<td>29.5 (24 to 38)</td>
<td>34 (26 to 42)</td>
<td>34 (26 to 42)</td>
<td>0.19</td>
</tr>
<tr>
<td>Duration of MV, days (mean ± SD)</td>
<td>33 ± 27</td>
<td>32 ± 36</td>
<td>32 ± 36</td>
<td>0.49</td>
</tr>
<tr>
<td>ICU LOS, days (mean ± SD)</td>
<td>39 ± 25</td>
<td>36 ± 34</td>
<td>36 ± 34</td>
<td>0.21</td>
</tr>
<tr>
<td>Hospital LOS, days (mean ± SD)</td>
<td>53 ± 33</td>
<td>49 ± 42</td>
<td>49 ± 42</td>
<td>0.11</td>
</tr>
<tr>
<td>Mortality, %</td>
<td>4/30 (12)</td>
<td>12/37 (25)</td>
<td>12/37 (25)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

ORGANISMS CAUSING VAP

<table>
<thead>
<tr>
<th>Organism</th>
<th>Number of Infections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcus pneumonia</td>
<td>13</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
</tr>
<tr>
<td>Acinetobacter species</td>
<td>6</td>
</tr>
<tr>
<td>Alcaligenes species</td>
<td>5</td>
</tr>
<tr>
<td>Enterobacter species</td>
<td>4</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>3</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>2</td>
</tr>
<tr>
<td>Stenotrophomonas maltophilia</td>
<td>2</td>
</tr>
<tr>
<td>Klebsiella pneumonia</td>
<td>2</td>
</tr>
<tr>
<td>Proteus mirabilis</td>
<td>1</td>
</tr>
</tbody>
</table>

WBC COUNT OVER TIME

MAXIMUM TEMPERATURE OVER TIME

*p < 0.05 when compared to Day 1
**PaO2/FiO2 OVER TIME**

**CLINICAL PARAMETERS OVER TIME**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Day 1</th>
<th>Day 3</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC (cells/µL)</td>
<td>12.9 ± 5</td>
<td>13.7 ± 5</td>
<td>NS</td>
</tr>
<tr>
<td>Tmax (°F)</td>
<td>101.8 ± 1.3</td>
<td>101.1 ± 1.1</td>
<td>NS</td>
</tr>
<tr>
<td>PaO2/FiO2</td>
<td>231.6 ± 107.9</td>
<td>200 ± 87</td>
<td>NS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Day 1</th>
<th>Day 6</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC (cells/µL)</td>
<td>12.9 ± 5</td>
<td>14.4 ± 5</td>
<td>NS</td>
</tr>
<tr>
<td>Tmax (°F)</td>
<td>101.8 ± 1.3</td>
<td>101.1 ± 1.4</td>
<td>NS</td>
</tr>
<tr>
<td>PaO2/FiO2</td>
<td>231.6 ± 107.9</td>
<td>218 ± 104</td>
<td>NS</td>
</tr>
</tbody>
</table>

**CONCLUSION**

- Clear, rapid resolution of clinical signs of VAP not seen in critically injured trauma patients
- Future studies should explore other methods to determine clinical response to VAP in trauma patients