Procalcitonin monitoring in patients with sepsis and/or pneumonia

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Disclosure

I have nothing to disclose concerning possible financial or personal relationships with commercial entities (or their competitors) that may be referenced in this presentation.

Objectives

Pharmacist Objectives
1. Discuss current literature related to the use of procalcitonin monitoring in patients with sepsis and/or pneumonia.
2. Interpret procalcitonin levels in patients with sepsis and/or pneumonia in light of clinical characteristics and comorbid disease states.

Technicians
1. Recognize procalcitonin as a biomarker specific for bacterial infections.

Procalcitonin (PCT)

• Produced by parafollicular cells of the thyroid, as well as neuroendocrine cells of the lung and intestine
• Increases in response to proinflammatory stimulus
• Production blocked by interferon-gamma
• Limited diagnostic accuracy

Review of the literature

<table>
<thead>
<tr>
<th>Study</th>
<th>Summary details</th>
<th>Outcome</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProHOSP</td>
<td>1359 patients with lower respiratory tract infections (LRTI)</td>
<td>3.0 day reduction in antibiotic duration</td>
<td></td>
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<tr>
<td>Schuetz (2009)</td>
<td></td>
<td>No difference in composite outcome of 30-day adverse outcomes including death, ICU admission, recurrent LRTI</td>
<td></td>
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<tr>
<td>ProBRAA</td>
<td>621 critically ill patients with suspected infection</td>
<td>2.7 day reduction in antibiotic duration</td>
<td>&lt;0.0001</td>
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<tr>
<td>Bouadma (2010)</td>
<td></td>
<td>No difference in mortality, infection relapse, or superinfection</td>
<td></td>
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<tr>
<td>ProREAL</td>
<td>International, multicenter observational study of 1759 patients with LRTI</td>
<td>1.5 day reduction in antibiotic duration</td>
<td>&lt;0.001</td>
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<tr>
<td>Albrich (2012)</td>
<td></td>
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<tr>
<td>SAPS</td>
<td>Multicenter, randomized trial in 15 hospitals of 1575 critically ill patients with suspected infection</td>
<td>1.22 day reduction in antibiotic duration</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>De Jong (2016)</td>
<td></td>
<td>No difference in 28-day or 1-year mortality</td>
<td>0.0122</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.0188</td>
</tr>
</tbody>
</table>
Procalcitonin algorithms

<table>
<thead>
<tr>
<th>Respiratory Infections (≤ 0.1 or drop &gt;90%)</th>
<th>Sepsis (0.25 OR drop &gt;90%)</th>
<th>Antibiotic Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.1 OR drop &gt;90%</td>
<td>&lt;0.25 OR drop &gt;90%</td>
<td>Discontinuation or de-escalation strongly encouraged</td>
</tr>
<tr>
<td>0.1 - 0.24 OR drop &gt;80%</td>
<td>0.25 - 0.49 OR drop &gt;80%</td>
<td>Discontinuation or de-escalation encouraged</td>
</tr>
<tr>
<td>0.25 - 0.5</td>
<td>0.5 - 1.0</td>
<td>Discontinuation or de-escalation discouraged</td>
</tr>
<tr>
<td>&gt;0.5</td>
<td>&gt;1.0</td>
<td>Discontinuation or de-escalation strongly discouraged</td>
</tr>
</tbody>
</table>

Other conditions that elevate PCT

- Renal dysfunction
- Congestive heart failure
- Severe trauma
- Pancreatitis
- Surgery
- Burns
- Cirrhotic shock
- Cancer

Renal dysfunction

<table>
<thead>
<tr>
<th>CKD Stage 1-4</th>
<th>CKD Stage 5 (dialysis naive)</th>
<th>Hemodialysis</th>
<th>Peritoneal dialysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grace, et al. proposed PCT threshold</td>
<td>0.25 ng/mL</td>
<td>0.50 ng/mL</td>
<td>0.50 ng/mL</td>
</tr>
<tr>
<td>Lee, et al. proposed PCT threshold</td>
<td>---</td>
<td>---</td>
<td>0.75 ng/mL</td>
</tr>
</tbody>
</table>

So how do we interpret PCT in patients with renal dysfunction?

- Track the trend
- Utilize low levels as a "rule out"
- Treat the patient, not the level

Case 1

SJ is a 69 year old female admitted to the hospital through the emergency department with sepsis secondary to a respiratory tract infection. She has a past medical history significant for type 2 diabetes mellitus, ESRD on hemodialysis, hypertension, and hypothyroidism. The attending physician orders a procalcitonin level, orders blood cultures, and starts the patient empirically on vancomycin and piperacillin/tazobactam.

WBC: 12.2k
Tmax: 99.2 degrees Fahrenheit
Chest x-ray: mild consolidation; atelectasis versus pneumonia
Blood cultures x 2: pending
Procalcitonin (pre-dialysis): 9.8 ng/mL

What PCT cut-offs should we use for patients with CHF?

- Track the trend
- Utilize low levels as a "rule out"
- Treat the patient, not the level

European Society of Cardiology (ESC) Guidelines:

"Assessment of procalcitonin levels may be considered in patients with AHF (acute heart failure) with suspected co-existing infection, particularly for the differential diagnosis of pneumonia and to guide antibiotic therapy, if considered."
Case 2
JR is a 72 year old male who presents to the emergency department with shortness of breath. He develops acute respiratory failure and is admitted to the intensive care unit (ICU) and placed on the ventilator. His past medical history includes congestive heart failure (ejection fraction 30%), hypertension, and osteoarthritis. His chest x-ray shows pleural effusion versus pneumonia, and the physician decides to treat the patient with broad spectrum antibiotics (vancomycin, cefepime).

WBC: 7.2k
Heart rate: 76 bpm
Tmax: 98.7 degrees Fahrenheit
BNP: 825 pg/mL
Procalcitonin: 0.15 ng/mL
Blood cultures: pending
Sputum culture: pending

Is it likely that the patient has a bacterial infection?

Would subsequent procalcitonin levels be helpful in this patient?

Pharmacist Assessment 1
Depending on a patient’s clinical characteristics, at what procalcitonin threshold would antibiotic de-escalation and/or discontinuation be warranted in a patient with suspected pneumonia?

a) 0.25
b) 0.50
c) 0.75
d) 1.00

Pharmacist Assessment 2
Which of the following condition(s) elevate procalcitonin levels even in the absence of bacterial infection?

a) Cancer
b) Severe trauma
c) End stage renal disease
d) Congestive heart failure

Technician Assessment 1
Procalcitonin is a biomarker than can help identify which type of infection?

a) Viral
b) Parasitic
c) Bacterial

table

Questions?

References