The Use of Procalcitonin to Improve Antibiotic Stewardship

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Disclosures

I have no actual or potential conflict of interest in relation to this presentation.

Objectives

● Describe the pathophysiology of procalcitonin.
● Cite advantages in using procalcitonin levels in patients with bacterial infection and sepsis.
● Discuss how the use of serial procalcitonin measurements may improve antibiotic stewardship.

Background

● First described in 1975
  ○ Precursor for calcitonin in chicken
● 1981—demonstrated synthesis of calcitonin in humans
● Currently more than 178 serum biomarkers for infection
● Procalcitonin most extensively studied

(Vijayan et al., 2017)

Pathophysiology

● Protein consisting of 116 amino acids
● Peptide precursor of calcitonin
● Normally undetectable in healthy patients

● Produced primarily by thyroid C-cells
● Also found in small amounts in neuroendocrine tissue
● High levels of cytokines and bacterial endotoxins cause increase in procalcitonin levels
Pathophysiology

- Procalcitonin not induced in most viral infections
- Some variation in bacterial infections
- Noninfectious causes increase procalcitonin

Use in Bacterial Infections

- **Respiratory Tract**
  - 2012 Cochrane meta-analysis
  - 14 randomized controlled trials
  - Similar protocols
  - Results
    - Strong reduction in initial antibiotic use for low-severity infections
    - Earlier cessation of antibiotics with relative reduction in duration

(Sager, Kutz, Mueller, & Schuetz, 2017)

- **Blood Stream Infections**
  - No gold standard exists
  - Procalcitonin demonstrated a high discriminatory ability
  - May help discriminate contamination from BSI

(Sager, Kutz, Mueller, & Schuetz, 2017)

- **Sepsis, Severe Sepsis, and Septic Shock**
  - Reduced antibiotic treatment courses
  - No increase in 28-day mortality
  - No increase in ICU or hospital length of stay
  - Helps predict severity of illness

(Sager, Kutz, Mueller, & Schuetz, 2017; Schuetz, Birkholz, Shanelin, Jones, Sager, Kline, . . . Shapiro, 2017)

- **Congestive Heart Failure**
  - May help differentiate heart failure exacerbation from infection
  - More information is needed

(Sager, Kutz, Mueller, & Schuetz, 2017)
Use in Bacterial Infections
● Urinary Tract Infections
  ○ Reductions in antibiotic use
  ○ No negative effects
(Sager, Kutz, Mueller, & Schuetz, 2017)

Use in Bacterial Infections
● Febrile Neutropenia
  ○ Accurate marker of infection
  ○ Predictor of severity
  ○ Not suitable for determining treatment cessation
(Sager, Kutz, Mueller, & Schuetz, 2017)

Use in Bacterial Infections
● Meningitis
  ○ Reduces antimicrobial consumption
  ○ Helps differentiate viral from bacterial meningitis
  ○ Useful in prognostication
(Sager, Kutz, Mueller, & Schuetz, 2017)
Who cares?

Antibiotic Resistance
- One of the most urgent threats to the public’s health
- 2 million people infected with antibiotic resistant bacteria
- 23,000 people die from these infections

Economic Impact
- At least 30% of antibiotic courses prescribed in the outpatient setting unnecessary
- Antibiotics for children down, but almost 30% still unnecessary
- Antibiotics cause 1 out of every 5 ED visits for adverse drug events
- $55 billion in direct and indirect costs annually
Economic Impact

- Approximately ⅓ of hospitalized patients and ⅔ of critically ill patients are on antimicrobial therapy
- Up to ⅓ of antibiotic prescriptions are inappropriate or not necessary

(Karanika, Paudel, Grigoras, Kalbasi, & Mylonakis, 2016)

Antibiotic Resistance

- Slow the emergence of resistant bacteria and prevent the spread of resistant infections
- Strengthen national One-Health surveillance efforts to combat resistance
- Advance development and use of rapid and innovative diagnostic tests for identification and characterization of resistant bacteria

Antibiotic Resistance

- Accelerate basic and applied research and development for new antibiotics, other therapeutics, and vaccines
- Improve international collaboration and capacities for antibiotic-resistance prevention, surveillance, control, and antibiotic research and development

Antibiotic Resistance

- Fiscal year 2017—Congress appropriated $163 million
- Antibiotic Resistance Solutions Initiative
  - Detect, Respond, and Contain
  - Prevent
  - Innovate

(CDC, 2018)

What is Antibiotic Stewardship?

- Integrated strategy of improving antimicrobial use, including drug resistance and nosocomial infections
- Selecting the appropriate agent, dose, therapy duration and route of administration

(Karanika, Paudel, Grigoras, Kalbasi, & Mylonakis, 2016)
GOALS

- Cost Containment
- Ensure Patient Safety
- Reduce Resistance

CDC Core Elements
- Antibiotic Stewardship in Acute Care: A Practical Playbook
- Hospital Antibiotic Stewardship Programs
- Outpatient Antibiotic Stewardship
- MITIGATE Antimicrobial Stewardship Toolkit
- Antibiotic Stewardship Core Elements at Small and Critical Access Hospitals

Core Elements of Hospital Antibiotic Stewardship
- Leadership Commitment
- Accountability
- Drug Expertise
- Action
- Tracking
- Reporting
- Education

Benefits of Antibiotic Stewardship Programs
- Improves clinical outcomes
- Decreases costs
- Helps reduce antibiotic resistance

Conclusion
- Use of serial procalcitonin measurements can help improve Antibiotic Stewardship programs
  - Reduces antibiotic usage
  - Reduces antibiotic duration
Figure 13: Questions

References


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