Ventilator-Associated Pneumonia: Key and Controversial Issues

Christopher P. Michetti, MD, FACS
Inova Fairfax Hospital, Falls Church, VA

Forrest “Dell” Moore, MD, FACS
Banner Healthcare System, Phoenix, AZ
Epidemiology

- Incidence 10 – 20% of ICU patients
- Rate (CDC) per 1000 ventilator days
  
  \[
  \text{# VAP episodes} \times 1000 \\
  \text{# ventilator days}
  \]

- Medical 2.2/1000 ventilator days
- Surgical 4.9/1000 ventilator days
- Trauma 8.1/1000 ventilator days

Current Diagnostic Strategies

**CLINICAL**
- Lung infiltrate that is new or progressing
  
  +

- ≥ 2 clinical signs of infection
  - Fever/hypothermia
  - Leukocytosis/leukopenia
  - Purulent sputum
  - Decline in oxygenation

- Clinical signs/+culture *without* an infiltrate:
  - ventilator-associated tracheobronchitis (VAT)

**BACTERIOLOGIC**
- Use of quantitative cultures of the lower respiratory tract
  - ESA
  - BAL
  - PSB

- Growth above a set threshold = VAP
Limitations of Both Strategies

- Sensitivity
- Specificity
- Lack of a gold standard for comparison
- “Ventilator-associated” arbitrary
- No consideration of pre-intubation aspiration
Controversies of Diagnosis

• Is the Clinical strategy sufficiently accurate?
• Is one diagnostic strategy superior?
• Are outcomes improved with either method?
• Which quantitative threshold should be used?
Limitations of Clinical Strategy

• Low specificity leads to overtreatment
• Clinical vs. postmortem histology\(^1\)
  – 69% sensitivity, 75% specificity
• Clinical vs. BAL
  – 39% of trauma patients w/ clinical criteria had VAP\(^2\)

\(^1\) Thorax 1999
\(^2\) Ann Surg 1998
Radiologic findings nonspecific

- Contusions
- ARDS
- Atelectasis
- Cardiogenic Edema
Limitations of Bacteriologic Strategy

• Resource availability
• Which threshold?
• Use lower threshold if ABX precede sampling
• Use of higher threshold may lead to undertreatment
• Technique variability; standardization
Limitations of Bacteriologic Strategy

• Outcome benefit unclear

• Improved survival
  – Fagon et al, Ann Int Med 2000 (RPT)
  – Shorr et al, CCM 2005, (meta-analysis)
    • OR 0.62 for death but NS

• No difference in survival
  – Heyland et al, CCCTG, NEJM 2006 (RPT, n=740)
    • Excluded MRSA and Pseudomonas pts
Advantages of Bacteriologic Strategy

- Direct visualization of airways
- Therapeutic
- Targeted specimen collection
- More specific antibiotic selection
- Decreased antibiotic use
Advantages of Bacteriologic Strategy

- Different or decreased antibiotic use
  - RCT: 11.9 vs. 7.7 ABX-free days using BAL\(^1\)
  - Meta-analysis of 4 randomized trials of clinical vs. quantitative culture\(^2\)
    - ABX changed 3 times more often with quant Cx

---

\(^1\) Ann Int Med 2000
\(^2\) CCM 2005
Diagnostic Threshold

• General diagnostic thresholds
  – \( > 10^3 \) for PSB, \( > 10^4 \) for BAL
  – \( > 10^5 \) proposed for trauma patients
    • False negative rate 10-15%
    • FNs more frequent with NFGNB (Pseud., Acinet.)
    • Higher FN not associated with excess mortality
  – \( 10^4 \) threshold used by CDC for surveillance
    • May result in overtreatment
    • Appropriate for most patient populations
Summary of Diagnostic Methods

Bacteriologic method offers advantages in specificity, subsequent guidance of antibiotic de-escalation, and decreased antibiotic use, but no mortality benefit has been proven.
Prevention and Risk Factors

• 3 domains of VAP Prevention:
  – Application of techniques that directly reduce the incidence of VAP by preventing or decreasing aspiration in intubated patients
  – Interventions that reduce time on the ventilator, and so avoid (“prevent”) VAP
  – Modification of risk factors that make patients susceptible to VAP
Direct Prevention of VAP

- Semirecumbent positioning
  - Head of bed 30 to 45 degrees
- Continuous subglottic aspiration
- Keep endotracheal cuff pressure >20 cm H2O
Preventing VAP by Avoiding Intubation

• Avoid endotracheal intubation
  – Noninvasive PPV for select populations
• Extubate earlier
• Daily assessment for extubation using SBT
• Daily sedation interruption protocol
• Use of ventilator weaning protocol
• Prevent unplanned extubation
• Decrease reintubation rates
Modifiable Risk Factors

- Conservative blood transfusion practice
- Appropriate stress ulcer prophylaxis
- Oral chlorhexidine rinsing
- Early mobilization
- Antibiotic stewardship
- Glucose control
- Hand hygiene
- ICU staff education about VAP reduction
- Early tracheostomy in select populations
Non-modifiable Risk Factors

- Prehospital aspiration
- Emergent intubation in prehospital or upon initial presentation
- Necessary blood transfusion for resuscitation
- Coma and Traumatic Brain Injury
- Contraindication or risk of raising head of bed
  - Unstable spinal injury
  - Open abdomen with loss of domain
- Age
- ARDS
Key Points about Treatment

• Antibiotics
  – Timing
  – Empiric choices
  – De-escalation
  – Length of treatment
Antibiotic Timing

• Delaying ABX when VAP is present leads to increased mortality
  – Patients with VAP whose initial antibiotics were delayed >24 hours had OR 7.7 for death
    • Increased overall and VAP-attributable mortality
Empiric Antibiotic Choice

• Cover broadly
• Include MRSA coverage
• Use local antibiograms for MDROs
• When initial ABX choice inadequate, mortality is higher
  – 15% vs. 37% - Rello, AJRCCM 1997;156(1):196-200.
De-escalation

• Adjust abx to the most focal agent with adequate coverage (MIC)
• Avoid continued broad coverage to prevent bacterial resistance
• No benefit of double-coverage for Pseudomonas
• No benefit to combination therapy
3 randomized studies on treatment duration

  - 8 vs. 15 days, 401 patients
  - 7 vs. 10 days, 30 patients
  - 8 vs. 12 days, 77 patients
Length of Treatment

• **Short course:**
  – Fewer antibiotic days
  – Lower recurrence with MDRO
  – No difference in overall recurrence*, mortality, ICU days, ventilator free days

• **Consider longer therapy for NFGNB**
  – Acinetobacter, Pseudomonas, Stenotrophomonas
  – *Higher recurrence of NFGNB with short course