Ventilator Associated Pneumonia: Current State of Prevention

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Ventilator Associated Pneumonia: Risk Factors (partial list)

- *Mechanical ventilation*
- Recumbent position
- Increased gastric pH
- Enteral feeding
- ↓ level of consciousness
- Advanced age
- Male sex
- Pre-existing pulmonary disease

[Link to CDC report](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm)

Pathogenesis of VAP

- Entry of pathogens into lower respiratory tract → colonization → infection
  - Leakage/aspiration around ET tube
    - Biofilm adherent to ET tube
    - Inhalation of contaminated aerosols
  - Direct inoculation
  - Hematogenous spread
- Infection often multifocal

Preventing VAP:↓ use of mechanical ventilation

- Facilitate/accelerate weaning
  - Protocols require adequate staffing
  - Reintubation also increases VAP risk

- Use non-invasive ventilation when possible
  - Positive pressure ventilation/facemask
  - COPD exacerbations, acute hypoxemic respiratory failure, immunocompromise with infiltrates and respiratory failure

Reducing vent use: The “sedation vacation”

- Daily interruption of sedation:
  - 128 patients on mechanical ventilation randomized to daily interruption of sedation until awake
  - Duration of ventilation 4.9 vs. 7.3 days (p=0.004)

Spontaneous awakening trial + spontaneous breathing trial

• Intervention arm had fewer:
  • Vent days
  • ICU days
  • Hospital days
  • Deaths
• No difference in reintubation rates

Reducing aspiration risk: Semi-recumbent positioning

<table>
<thead>
<tr>
<th>Study</th>
<th>Semirecumbent (n/N)</th>
<th>Supine (n/N)</th>
<th>OR (fixed) 95% CI</th>
<th>Weight %</th>
<th>OR (fixed) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drakulovic</td>
<td>3/39</td>
<td>16/47</td>
<td>0.16 [0.04, 0.61]</td>
<td>36.83</td>
<td></td>
</tr>
<tr>
<td>Van Nieuwenhoven</td>
<td>16/112</td>
<td>20/109</td>
<td>0.74 [0.36, 1.52]</td>
<td>47.77</td>
<td></td>
</tr>
<tr>
<td>Keeley</td>
<td>5/17</td>
<td>7/13</td>
<td>0.36 [0.08, 1.62]</td>
<td>15.40</td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>168</strong></td>
<td><strong>169</strong></td>
<td></td>
<td>100.00</td>
<td><strong>0.47 [0.27, 0.82]</strong></td>
</tr>
</tbody>
</table>

- One of three RCTs demonstrated significant ↓ in VAP
- Overall trend favors semirecumbent position
- Patients should not be completely supine.

Reducing aspiration risk: Continuous subglottic suctioning

- Meta-analysis, 5 studies, 896 pts
  - VAP RR = 0.51; 95% CI 0.37-0.71
  - Greatest effect in those intubated >72 hrs

Preventing VAP: Choice of ulcer prophylaxis?

- Ranitidine vs. Al/MgOH vs. sucralfate

N = 244 randomized; 213 observed > 4 days

Larger, more recent studies demonstrate that H2 blockers or PPIs can more effectively prevent GI bleeding without increasing the VAP rate...

Preventing VAP: Chlorhexidine oral care

- 2 meta-analyses published in 2007:
  - 11 RCTs → RR 0.56 [95% CI, 0.39-0.81]¹
  - 7 RCTs → RR 0.58 [95% CI, 0.44-0.72]²

<table>
<thead>
<tr>
<th>Study</th>
<th>CHX n/N</th>
<th>Control n/N</th>
<th>RR (fixed) 95% CI</th>
<th>Weight %</th>
<th>RR (fixed) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeRiso 1996¹²</td>
<td>3/173</td>
<td>9/180</td>
<td>0.57</td>
<td>5.73</td>
<td>0.35 [0.10, 1.26]</td>
</tr>
<tr>
<td>Fourrier 2000¹³</td>
<td>5/30</td>
<td>18/30</td>
<td>1.17</td>
<td>11.69</td>
<td>0.28 [0.12, 0.65]</td>
</tr>
<tr>
<td>Houston 2002⁸</td>
<td>4/270</td>
<td>9/291</td>
<td>0.63</td>
<td>5.63</td>
<td>0.48 [0.15, 1.54]</td>
</tr>
<tr>
<td>Grap 2004⁹</td>
<td>4/7</td>
<td>3/5</td>
<td>2.27</td>
<td>2.27</td>
<td>0.95 [0.36, 2.49]</td>
</tr>
<tr>
<td>Fourrier 2005¹⁰</td>
<td>14/114</td>
<td>17/114</td>
<td>1.10</td>
<td>11.04</td>
<td>0.82 [0.43, 1.59]</td>
</tr>
<tr>
<td>Koemann 2006¹⁵</td>
<td>13/127</td>
<td>23/130</td>
<td>1.11</td>
<td>14.76</td>
<td>0.58 [0.31, 1.09]</td>
</tr>
<tr>
<td>Segers 2006¹⁶</td>
<td>45/485</td>
<td>74/469</td>
<td>1.10</td>
<td>48.87</td>
<td>0.59 [0.42, 0.83]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>1206</td>
<td>1219</td>
<td></td>
<td>100.00</td>
<td>0.56 [0.44, 0.72]</td>
</tr>
</tbody>
</table>

Preventing VAP: Antibiotic Use: Selective DD +/- systemic

- Complex literature, variety of regimens used, definitions for outcome measure, etc.
  - 16 RCTs, 3361 patients\(^1\)
    - OR 0.35 [95% CI, 0.29-0.41] for VAP
    - OR 0.8 [95% CI, 0.69-0.93] for mortality
  - 54 RCTs, 9473 patients\(^2\)
    - OR 0.11 [95% CI, 0.06-0.2] for Gram negative LRTI
    - OR 0.52 [95% CI, 0.34-0.78] for Gram positive LRTI

Digestive or Oropharyngeal Decontamination?

- Cluster randomized, crossover trial in 13 Dutch ICUs, S-DD v. S-OD v. standard care
- All regimens used over 6 months in each ICU
- S-DD: IV cefotaxime + tobra-colistin-ampho B
- S-OD: oropharyngeal application only (T-C-A)
- Only those with expected ICU stay > 72 hrs
- 5939 enrolled, 28 day mortality = 27.5%
- MLR model compared to standard care:
  - S-OD: OR 0.86 [0.74-0.99] for 28 d mortality
  - S-DD: OR 0.83 [0.72-0.97] for 28 d mortality

S-DD for VAP Prevention

• **Pro:**
  - Accumulated trials data support efficacy in reducing VAP and mortality

• **Cons:**
  - Impact of systemic + oral antimicrobials on resistance emergence
  - Can oral decontamination with chlorhexidine provide similar benefit?
Preventing VAP: Antimicrobial (silver) coated ET tubes

- 2003 pts randomized
- Among those intubated > 24 hrs:
  - 4.8 vs. 7.5% micro-confirmed VAP, p=0.03
- No differences in intubation time, LOS, mortality

Kollef et al. JAMA 2008;300:805.
Multifactorial Interventions: The “ventilator bundle”

- Implementation of those interventions with the supporting evidence/feasibility
  - Hand Hygiene
  - Elevation of HOB
  - “Sedation vacation” each day
  - Assessment of readiness to wean
  - PUD and DVT prophylaxis
  - Chlorhexidine oral care (new)

www.ihi.org
The IHI Ventilator Bundle: Meta-analysis

- Only four studies met inclusion criteria
  - All had methodologic problems
    - All were “before-after” study designs
    - Little information re diagnostic approach before and after
    - Selection/publication bias, confounding?
- 38-60% reduction in VAP post-intervention
- “Lack of methodologic rigor of the reported studies precludes any conclusive statements about the bundle’s effectiveness. The vent bundle is not a viable quality measure in the ICU….”

Ventilator Associated Pneumonia: Summary

- VAP prevention literature is murky, but:
  - IHI bundle (including CHG oral care)
  - CSS if expect to be on vent >72 hrs
- Or for all? Difficult to predict duration….
- Other approaches (e.g. silver coated ET tubes, etc.) if rate remains elevated despite above approaches
Questions?