Hospital acquired pneumonia
&
Ventilator associated pneumonia
Diagnosis and management

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Defining the illness

Community Acquired Pneumonia <48 hours after admission (CAP)

Hospital Acquired Pneumonia >48 hours after admission (HAP)

Healthcare Associated Pneumonia (HCAP)

Ventilator associated pneumonia >48 hrs after intubation (VAP)
Epidemiology

Pneumonia the leading cause of hospital acquired infection

- 0.5 – 1% of all hospital admissions
- Mortality 10 – 30% (MDR – 70%)
- Most deaths outside ICU
- Huge health resource implications
- Post surgery pneumonia – 20% mortality

Ventilator associated?

- Intubation associated pneumonia
- Endotracheal tube associated pneumonia
- 10 international guidelines in 7 years (50% expert opinion)
The fate of hospitalised patients?

- 45% healthy volunteers microaspirate during sleep
- Rate may double in critically ill
- 75% of patients critically ill - oropharynx colonised within 48 hours
- Mechanical barrier
- Humoral and cellular response
HAP, HCAP & VAP

Risk factors

- Age >70
- Low GCS
- PPI/H$_2$ Blockers
- Chronic illness
- Chronic lung disease
- Aspiration
- Chest surgery
- Antibiotics
- Seasonal
- Frequent vent circuit changes
Diagnosis of HAP, HCAP & VAP

(ATS/IDSA 2005)

The clinician should suspect infection:

- Fever*
- Leukocytosis*
- Purulent sputum*
- Decline in oxygenation

In the presence of a progressive lung infiltrate on CXR with two of signs*

Gives best clinical prediction BUT, lack specificity

**DANGER:** Over treatment of infection
HAP/VAP - UCLH clinical approach

White cell count
Fever
CRP
Appropriate CXR

Hourly ventilator settings check
- Increasing resp rate
- Decreasing tidal volume
- Increasing ventilation
- Declining P/F ratio

Increasing ventilator settings
A randomised trial of diagnostic techniques for VAP
(The Canadian Critical Care Trials group) n=740

BAL + Quantitative V Endotracheal aspiration + non – quantitative

* No difference in primary endpoint – 28 day mortality*
  • Similar rates of overall antibiotic use
  • Similar days alive without antibiotics
  • Similar length of ICU stay
  • Similar organ dysfunction score

2006;355:2619-30
Guideline for early, appropriate antibiotics

- `Inappropriate antibiotics cost lives`  Kollef M. Chest. 2006

- `Delays in initial therapy costs lives`  Iregui. Chest. 2002

- `Physicians deviating from ATS guidelines for HCAP therapy resulted in increased mortality`  Zilberg. Chest. 2008

- `Prescribing policy based on resistance patterns locally improves outcome`  Beardsley Chest. 2006

- `Single agent, unless guided by high risk of MDR factors`  Aarts M. Crit Care Med. 2008
Infection suspected

Obtain sample (Non-BAL /semi quantitative )

Empiric therapy – with local guidance

48 - 72 hours assess clinically and micro

improvement

No

Cult neg

Consider diagnosis

Cult pos

Consider antibiotics diagnosis

Yes

Cult neg

Stop Antibiotics?

Cult pos

De-escalate (5-7 days)
### VAP is deadly and expensive

<table>
<thead>
<tr>
<th>Variable</th>
<th>No VAP (n=692)</th>
<th>VAP (n=127)</th>
<th>( p ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis n(%)</td>
<td>75 (11)</td>
<td>43 (44)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ICU LOS</td>
<td>4 days</td>
<td>26 days</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Hospital LOS</td>
<td>13 days</td>
<td>38 days</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Death n (%)</td>
<td>237 (34)</td>
<td>64 (50)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Total cost</td>
<td>$21,620</td>
<td>$70,568</td>
<td>&lt;.001</td>
</tr>
<tr>
<td># ICD-9 codes</td>
<td>9</td>
<td>10</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Give your patients a **FAST HUG** (at least) once a day

- Feeding
- Analgesia
- Sedation
- Thrombo-prophylaxis
- Head of bed elevation
- Stress ulcer prophylaxis
- Glucose control

Vincent JL. 2005;33:1225-1229
Feeding

NG tube protocols

GI protection protocols

Patient positioning

Feeding protocols
Head up (Semi-recumbent positioning)

- Defined as elevating the head of the bed at least $30^\circ$
- One randomised, prospective trial:
  - 86 patients positioned semi-recumbent ($30^\circ$) or supine
  - Frequency of VAP assessed (clinical and quantitative BAL) 20% V 38% VAP

Ulcer prophylaxis

RCT, comparing 3 strategies H₂ antag, Mg hydrox & Sucralfate

Sucralfate reduced late pneumonia (5% v 16% v 21%)

- Lower gastric pH
- Lower gastric colonisation
- Non-significant trend to bleeding (Prod`hom. Ann Int Med 1994)

Large cohort study PPI v H₂ antag (>3 days hospitalised)

PPI associated with significantly more HAP (not H₂ antag)

Herzig. JAMA. 2009

Where possible we avoid these drugs in those NOT at considerable risk of GI haemorrhage and use H2 > PPI > antacids
### Analgesia & Sedation

Rapid shallow breathing index = \( f/TV \) (BPM/L) where <105 predictive of extubation

<table>
<thead>
<tr>
<th>Score</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Agitated, restless</td>
</tr>
<tr>
<td>2</td>
<td>Awake, uncomfortable</td>
</tr>
<tr>
<td>1</td>
<td>Aware, but calm</td>
</tr>
<tr>
<td>0</td>
<td>Roused by voice</td>
</tr>
<tr>
<td>-1</td>
<td>Roused by movement</td>
</tr>
<tr>
<td>-2</td>
<td>Roused by noxious stimulus</td>
</tr>
<tr>
<td>-3</td>
<td>Unrousable</td>
</tr>
</tbody>
</table>
Thromboprophylaxis

Mechanical compression devices

Anti embolic stockings

Early mobilisation

LMWH
Development of VAP

Odds ratio

Days of intubation

Rello and Diaz Crit Care Med 2003 31(10):2544-51
Therapist-Driven Weaning Protocols (MDT approach to weaning)

- RCT of 300 patients
- Physician order versus RN- and RT- driven weaning trials
- Duration of mechanical ventilation and cost were both lower
- Less complications in intervention group

Ely et al. *NEJM* 1996 335:1864-69
Sterile gowns  
Plastic aprons  
Latex free gloves  

Infection Control – Care bundles
Selective decontamination of the digestive tract
(antiseptic mouth wash, non-absorbable antibiotics, systemic antibiotics)

Oropharynx:
2007 metaanalysis 11 trials, 3242 patients
Oral antibiotics / antiseptic / placebo / standard mouth care
VAP reduced by oral mouthwash only
Chlorhexidine 0.12% 15mls/bd
Neither affected outcome

Less VAP, same mortality same length of ventilation
Safe, cheap and easy to apply
Digestive tract
(Against aerobic bacilli and Candida spp Maintaining anaerobic flora)

5939 patients RCT

Cefotaxime iv, Colistin, Tobramycin, Amphotericin B

Control group death rate 27.5%
Death rate reduction at 28 days

3.5% gut decontamination
2.9% oropharyngeal decontamination

De Smet et al. NEJM 2009. 1;360(1):20-31
UCLH approach (and UK)

Better studies report small improvements. Implication for medical patients is small.

C-Difficile, Gram +ve/-ve organisms real concern.

Concerns for resistance not upheld in literature.

British Society of Antimicrobial Chemotherapy support.

National Institute of Clinical Excellence

- More UK based research
- Specialist Advisor concerns
Aspiration past the cuff:
(basic steps for prevention)

- Semi-recumbent positioning
- Avoid gastric over-distention
- Avoid unnecessary sedation
- Discontinue nasogastric tube
- Positive end expiratory pressure

Aspiration
Gross aspiration or microaspiration around endotracheal tube cuff
Continuous Aspiration of Subglottic Secretions (CASS)

- Secretions above ETT cuff may increase risk of aspiration
- Removal decreases the pressure gradient that promotes leakage and the volume that can leak
- Special endotracheal tube with a separate suction lumen
- Suctioning of secretions can be continuous or intermittent
Subglottic secretion drainage with integrated suction line
Continuous aspiration of Subglottic secretions (CASS)

5 studies, 896 patients intubated

- Continuous aspiration
- Halved incidence VAP
- Reduced length of ICU stay
- Reduced antibiotic use

## Efficacy of Subglottic Suctioning

<table>
<thead>
<tr>
<th>Author and Publish Date</th>
<th>Patient Profile</th>
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</thead>
<tbody>
<tr>
<td>Liu 2006⁹</td>
<td>Patients expected to be ventilated &gt;48 hrs</td>
</tr>
<tr>
<td>Smulders 2002⁹</td>
<td>Med/Surg ICU patients expected to be ventilated &gt;72 hrs</td>
</tr>
<tr>
<td>Bo 2000¹⁰</td>
<td>Surgical ICU patients expected to be ventilated &gt;72 hrs</td>
</tr>
<tr>
<td>Kollef 1999¹¹</td>
<td>Cardio-Thoracic ICU patients (average ventilation 1.5 days)</td>
</tr>
<tr>
<td>Valles 1995¹²</td>
<td>Med/Surg ICU patients expected to be ventilated &gt;72 hrs</td>
</tr>
<tr>
<td>Mahul 1992¹³</td>
<td>Med/Surg ICU patients expected to be ventilated &gt;72 hrs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percent VAP rate, Study</th>
<th>Percent VAP rate, Control</th>
<th>Relative risk reduction*</th>
</tr>
</thead>
<tbody>
<tr>
<td>6%</td>
<td>20%</td>
<td>70%</td>
</tr>
<tr>
<td>4%</td>
<td>16%</td>
<td>75%</td>
</tr>
<tr>
<td>23%</td>
<td>45%</td>
<td>49%</td>
</tr>
<tr>
<td>5%</td>
<td>8.2%</td>
<td>Not statistically significant</td>
</tr>
<tr>
<td>18.4%</td>
<td>32.5%</td>
<td>43%</td>
</tr>
<tr>
<td>13%</td>
<td>29%</td>
<td>55%</td>
</tr>
</tbody>
</table>
Cuff Technology

- Current cuffs are not 100% occlusive
- Folds in wall create channels that allow fluid leakage
- Folding is related to cuff shape and material
Experiments with cuff profile

- Taper shaped cuff
- Cuff material is minimized
- Limited pathway for aspiration

UCLH approach to VAP Prevention (Teamwork)

- Nurse
- Patients
- Doctor
- Physio