Pleural Empyema: the Australian Experience

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(Don’t go to Sydney!)
Empyema = pus within
Overview

• Epidemiology
• Investigations
• Microbiology
• The treatment controversy:

The Fuss about Pus!
• Pleural space contains 0.3 mL/kg of fluid

• Pleural fluid circulation - lymphatics deal with several 100 mLs of extra fluid/ 24 hrs
Secretion

Absorption

Lung infection

Inflammation

Cytokines from mesothelial cells

Inflammatory cells

Bacterial invasion

Vascular permeability

Neutrophil migration

Procoagulant state

fibrinolysis

Fluid
Burden of empyema in Australia

Pneumonia admissions per million

Empyema admissions per million
Guidelines

• British Thoracic Society (2005):
  www.brit-thoracic.org.uk

• Thoracic Society of Australia and New Zealand (2011):
  www.thoracic.org.au
Investigation pathway to diagnosis

Pneumonia with fever after 48 hrs of appropriate therapy and/or clinical deterioration

- CXR
  - Fluid Present?
    - Yes
      - Consult with Respiratory Paediatrician
    - No
      - Antibiotic (Oral or IV)
        - Persistent fever and/or clinical deterioration
          - Intravenous antibiotics
            - Chest Ultrasound
              - Confirms fluid presence
              - Stages complexity
              - Assesses volume
              - Guides drainage site
  - Signs of empyema: respiratory distress, prefers to lie on one side, scoliosis, decreased expansion, decreased vocal fremitus, stony dull to percussion, absent breath sounds, decreased vocal resonance, whispering petriloquy, mediastinal shift
# Physical examination in empyema

<table>
<thead>
<tr>
<th>Clinical sign</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased expansion</td>
<td>0.74</td>
<td>0.91</td>
<td>0.68</td>
<td>0.93</td>
</tr>
<tr>
<td>Decreased tactile vocal fremitus</td>
<td>0.82</td>
<td>0.86</td>
<td>0.59</td>
<td>0.95</td>
</tr>
<tr>
<td>Stony dullness</td>
<td>0.53-0.89</td>
<td>0.71</td>
<td>0.55</td>
<td>0.97</td>
</tr>
<tr>
<td>Absent breath sounds</td>
<td>0.42-0.88</td>
<td>0.83-0.9</td>
<td>0.57</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Adapted from Diaz-Guzman and Budev. Cleveland Clinic J Med 2008;75:297-303
Investigations - Ultrasound

- Differentiate pleural fluid from solid lung
- Estimates size and position
- Demonstrates loculations and debris
- Identify abscesses
- Marks spot for drain insertion
- Very user dependent
Septations seen on thoracic ultrasound
Pus and Septations seen during video assisted thoracoscopic surgery (VATS)
No routine role for chest computed tomography
Blood Investigations

- ↑ White cell count
- ↑ CRP/ESR/procalcitonin
  - Not good for differentiating viral/bacterial pneumonia
  - Useful to monitor progress in empyema
- ↑ Platelets
- Blood cultures- minority will be positive
- LDH
**Pleural Fluid Investigations**

- **Microbiology**
  - Culture
  - Stain for AFB
  - Molecular studies

- **Cytology**
  - ↑ lymphocytes in malignancy and TB

- **Biochemistry**
  - No data for LDH, pH
Australian Research Network in Empyema (ARNiE)
### Bacteria identified from blood and pleural fluid investigations


<table>
<thead>
<tr>
<th>Organism</th>
<th>No. (%) positive samples</th>
<th>Blood culture, n = 152</th>
<th>Culture, n = 160</th>
<th>PCR, n = 145</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcus pneumoniae</td>
<td>19 (12.5)</td>
<td></td>
<td>12 (7.5)</td>
<td>74 (51)</td>
</tr>
<tr>
<td>S. pyogenes</td>
<td>3 (2.0)</td>
<td></td>
<td>14 (8.8)</td>
<td>NA</td>
</tr>
<tr>
<td>S. milleri</td>
<td>NA</td>
<td></td>
<td>4 (2.5)</td>
<td>NA</td>
</tr>
<tr>
<td>MSSA</td>
<td>1 (0.7)</td>
<td></td>
<td>11 (6.8)</td>
<td>6 (4.1)</td>
</tr>
<tr>
<td>MRSA</td>
<td>1 (0.7)</td>
<td></td>
<td>6 (3.8)</td>
<td>7 (4.8)</td>
</tr>
<tr>
<td>Coagulase-negative staphylococci</td>
<td>4 (2.6)</td>
<td></td>
<td>2 (1.3)</td>
<td>NA</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>1 (0.7)</td>
<td></td>
<td>NA</td>
<td>4 (2.8)</td>
</tr>
<tr>
<td>Mycobacterium tuberculosis</td>
<td>NA</td>
<td></td>
<td>1 (0.6)</td>
<td>NA</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>NA</td>
<td></td>
<td>1 (0.6)</td>
<td>NA</td>
</tr>
<tr>
<td>Mycoplasma pneumoniae</td>
<td>NA</td>
<td></td>
<td>NA</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>Chlamydia pneumoniae</td>
<td>NA</td>
<td></td>
<td>NA</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>Other†</td>
<td>4 (2.6)</td>
<td>4 (2.5)</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>
**S. Pneumoniae serotypes**


<table>
<thead>
<tr>
<th>Serotype</th>
<th>No. (%) specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV7 serotypes</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td>9V/9A</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td>Nonvaccine serotypes</td>
<td></td>
</tr>
<tr>
<td>19A</td>
<td>20 (36.4)</td>
</tr>
<tr>
<td>3</td>
<td>18 (32.7)</td>
</tr>
<tr>
<td>1</td>
<td>8 (14.5)</td>
</tr>
<tr>
<td>7F/7A</td>
<td>2 (3.6)</td>
</tr>
<tr>
<td>22F/22A</td>
<td>2 (3.6)</td>
</tr>
<tr>
<td>6C</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td>15F</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td>21</td>
<td>1 (1.8)</td>
</tr>
</tbody>
</table>
S. Pneumoniae serotypes in relation to age and vaccination status
Vaccine-serotypes identified from pleural fluid in ARNiE compared with national surveillance data
Pleural fluid – immunochromatogenic assay
Utility of a bedside immunochromatographic test

<table>
<thead>
<tr>
<th></th>
<th>Pleural fluid (n = 137)</th>
<th>Blood (n = 120)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Streptococcus pneumoniae</td>
<td>Other organisms</td>
</tr>
<tr>
<td>Culture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. tested</td>
<td>135</td>
<td>135</td>
</tr>
<tr>
<td>No. positive</td>
<td>11</td>
<td>34</td>
</tr>
<tr>
<td>%</td>
<td>8.1</td>
<td>25.2</td>
</tr>
<tr>
<td>lytA PCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. tested</td>
<td>137</td>
<td></td>
</tr>
<tr>
<td>No. positive</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>49.6</td>
<td></td>
</tr>
<tr>
<td>Binax NOW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. tested</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>No. positive</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>46.9</td>
<td></td>
</tr>
</tbody>
</table>

PPV = 93%
NPV = 84%
Aims of treatment

- Sterilise pleural cavity
- Get rid of fluid
- Return to normal activity
- Return to normal lung function
- Expand the lung
- Early discharge
Controversies in Management

• Antibiotics
• recurrent thoracocentesis
• chest tube drainage alone
• chest drain + fibrinolytics
  – Thomson et al. Thorax 2002;57:343
• Video assisted thoracoscopic surgery
• Open decortication

↑ Length of stay
Controversies in Management

- Antibiotics
- recurrent thoracocentesis
  - Shoseyov et al. Chest 2002;121:836
- chest tube drainage alone
- chest drain + fibrinolytics
  - Thomson et al. Thorax 2002;57:343
- Video assisted thoracoscopic surgery
  - Sonnappa et al. Am J Respir Crit Care Med 2006;15:221-7
- Open decortication

↑ Technical skills
Controversies in Management

- Antibiotics
- recurrent thoracocentesis
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- chest tube drainage alone
- chest drain + fibrinolytics
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  - Sonnappa et al. Am J Respir Crit Care Med 2006;15:221-7
- Open decortication

↑ Cost
VATS decortication
Pathway from diagnosis of empyema

Small amount* of fluid and mild respiratory distress
- Intravenous antibiotics
- Persistent fever and/or clinical deterioration
  - Re-evaluate

Large amount of fluid and moderate/severe respiratory distress
- Refer to respiratory paediatrician with early surgical consultation
  - Percutaneous small bore chest drain insertion and fibrinolytics
  - VATS
    - Clinical improvement?
      - No
        - Consider CT chest
        - Reconsult surgeons
        - Consider further surgical intervention
      - Yes
        - Change to oral antibiotics
        - Discharge if afebrile for 24 hours
        - Oral antibiotics 1-6 weeks
        - Follow up CXR at 4-6 weeks

Drain adequacy
Lung abscess
Bronchopleural fistula
Necrotising pneumonia
Atypical pneumonia
Host factors
Wrong diagnosis
Choosing Fibrinolytics versus VATS

<table>
<thead>
<tr>
<th>Choose Fibrinolytics if:</th>
<th>Choose VATS if:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical competence in chest drain insertion available</td>
<td>Technical competence and experience in VATS available</td>
</tr>
<tr>
<td>Technical skill and experience in VATS unavailable</td>
<td>Don’t mind paying for increased costs!</td>
</tr>
<tr>
<td>Child where anesthesia risk too high</td>
<td>Surgeons inserts chest drains under general anesthetic anyway</td>
</tr>
<tr>
<td></td>
<td>Septations and loculations advanced?</td>
</tr>
</tbody>
</table>
Inflammation in loculated and free-flowing exudates

Conclusions from recent experience

• Empyema epidemiology is changing
• Molecular surveillance is important
• Extending vaccine coverage is indicated
• Management depends on local expertise
• Refer for specialist help sooner improves treatment outcomes
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